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Retrospective study on the species distribution and common diseases in exotic pets presented to the Clinic for Zoo Animals, Exotic Pets and Wildlife, University of Zurich from 2005 to 2014

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1 SUMMARY

1.1 Summary

The analysis of patient records describing consultations for privately owned exotic pets presented between 2005 and 2014 at the Clinic for Zoo Animals, Exotic Pets and Wildlife of the University of Zurich yielded information on the most common species presented as well as their most common diseases.

Data characterising only the type of consultations showed that more than half of the animals were presented for the first time and almost 30% were presented as emergencies, 4% of consultations were referrals. Inpatient admission was required for 31% of animals. The rate for a successful discharge was 84%, with 40% of patients that still had to be given medication by the owner. Mammals (n=8214) were presented twice as often as reptiles (n=3714) and birds (n=3261). The 5 most common species or groups were rabbits (*Oryctolagus cuniculus*, n=3047), guinea pigs (*Cavia porcellus*, n=2165), tortoises (*Testudo* ssp., n=1441), budgerigars (*Melopsittacus undulatus*, n=1003) and rats (*Rattus norvegicus*, n=891). During the 10-year study period, the percentage of consultations for guinea pigs, ferrets (*Mustela putorius furo)*, macaws (*Ara ssp.)*, Amazon parrots (*Amazona ssp.)* and green iguanas (*Iguana iguana*) decreased significantly. In the same time period, small rodents, backyard poultry species and *Sauria ssp.* (mainly the bearded dragons) showed an increase in relative annual consultations. The main disease complex in *Lagomorphs* and rodents was dental disease. Other frequent diagnoses for mammals were gastrointestinal tract disease, trauma or disorders of the reproductive tract. For the avian species, gastrointestinal tract disorders as well as respiratory tract disease were the principal diagnoses. Reptiles suffered most often from gastrointestinal tract disease originating from parasitic infections; however, trauma was also a common diagnosis in this group.

Recommendations in regards to course contents and research include a special focus on dental problems in mammals, diseases seen in the psittacines species, but also the medical and legal aspects of backyard poultry medicine. Knowledge of optimal housing conditions and handling could help to instruct owners of animals presented with trauma to avoid further injuries to the animal, regardless of the species. Research into newly discovered diseases in reptiles is ongoing, and future veterinarians should be encouraged to follow the development in a timely manner.

1.2 Zusammenfassung

Die Erfassung der Patientendaten von Heimtieren, die zwischen 2005 und 2014 an der Klinik der Zoo-, Heim- und Wildtiere der Universität Zürich vorgestellt wurden, lieferte wichtige Hinweise über die vorgestellten Arten und deren Krankheitskomplexe.

Oft wurden die Tiere als Erstkonsultationen an der Klinik vorgestellt, 30% als Notfallkonsultation und 4% aller Konsultationen waren Überweisungen. Nach 31% der Konsultationen wurden Patienten stationär aufgenommen. Erfolgreich entlassen wurden 84% der Tiere, wobei für 40% die Therapie zu Hause fortgesetzt wurde. Säugetiere (n=8214) waren die häufigste Tiergruppe, gefolgt von Reptilien (n=3714) und Vögeln (n=3261). Die 5 häufigsten Spezies waren Kaninchen (*Oryctolagus cuniculus*, n=3047), Meerschweinchen (*Cavia porcellus*, n=2165), Landschildkröten (*Testudo ssp*., n=1441), Wellensittiche (*Melopsittacus undulatus*, n=1003) und Ratten (*Rattus norvegicus*, n=891). Über die untersuchten 10 Jahre reduzierten sich der prozentuale Anteil an Konsultationen für Meerschweinchen, Frettchen (*Mustela putorius furo)*, Aras (*Ara ssp.)*, Amazonen (*Amazona ssp.)* und Iguanas (*Iguana iguana*) signifikant. Währenddessen zeigten die Kleinnager, Heimgeflügel sowie Bartagamen (*Pogona vitticeps)* eine deutliche Zunahme. Die Hauptkrankheitsursache bei *Lagomorpha* und *Rodentia* waren Zahnerkrankungen sowie Erkrankungen des Magen-Darm-Trakts, des Reproduktionstrakts oder Traumata. Vogelpatienten waren grösstenteils von Erkrankungen der Verdauungs- oder Atemorgane betroffen. Reptilien litten vor allem an Erkrankungen des Verdauungsapparates und Traumata.

Zusammenfassend können folgende Vorschläge für das Curriculum und zukünftige Forschung gegeben werden: im Bereich der Säugetiere sollten Zahnerkrankungen ausführlich besprochen werden. Im Bereich der Vogelmedizin sind die Papageienvögeln von besonderer Bedeutung sowie deren Erkrankungen im Bereich der Verdauungs- und Atemorgane. Fundiertes Wissen bezüglich korrekter Haltung und Manipulation der Tiere ist sehr wertvoll für eine korrekte Beratung der Besitzer im generellen und im speziellen, wenn Tiere wegen haltungsbedingten Pathologien vorgestellt werden wie zum Beispiel Traumata oder Mangelernährung. Die laufende Forschung in Bezug auf Erkrankungen bei Reptilien sollte von Studenten der Tiermedizin genauso wie von praktizierenden Tierärzten im Auge behalten werden, um zeitnah auf neue Erkenntnisse reagieren zu können.

2 INTRODUCTION

The Clinic for Zoo Animals, Exotic Pets and Wildlife of the University of Zurich is an integral part of the Veterinary Teaching Hospital in Zurich. The clinic averages a workload of around 1300 consultations for privately owned exotic pets per year. The range of species covered by the clinic is large and extends over several branches of the phylogenetic tree compared to more specialised clinics that focus on a few species only (i.e. dogs and cats, horses or ruminants). At the same time, the team is also involved in research and teaching.

In the 5-year veterinary medicine curriculum, there are 28 hours allocated to exotic pet medicine as part of the core curriculum. Students with a small animal focus track have additional lectures and practical training. The limited time available does not match the large number of species and their potential diseases. It is therefore imperative to carefully adapt the content of the few lectures to reflect the most important species and their diseases. One has to take into consideration that the popularity of a specific species is subject to fluctuations, as is the importance of respective illnesses for practitioners. Another factor with a lot of impact is the research into species specific diseases, which made progress in the past years (e.g. Bornavirus in *Psittaciformes* or Boid Inclusion Body Disease (Hepojoki et al. 2015) and Nidovirus in *Serpentes* (Dervas et al. 2017)).

The aim of this study is to describe the species distribution and the common diseases of animals that have been presented at the clinic between 2005 and 2014. In 2006 an earlier study was published on distribution of species and diseases in exotic pets seen between 1994 and 2003 (Langenecker 2006). The results of the current study will highlight the changes that have occurred since the previous investigation, and which species and diseases are important today. Finally, based on both studies, it will be possible to determine applicable research topics and to shape future course contents for veterinary students.

3 LITERATURE REVIEW

To predict what animals will likely be presented at an exotic pet practice, one could initially check census data of pet ownership and animal welfare legislation. In Switzerland, it is estimated that there are as many rabbits kept as pets as dogs (17%), birds follow closely (12%) and tortoises only represent 1% of privately owned pets (FEDIAF 2016). Numbers for all of Europe in 2016, birds were the favourite exotic pet (60%), followed by small mammals (30%) and reptiles (10%). In the US, rabbits were the most common exotic animal in 2012 (excluding fish). There was an increase in total numbers between 2007 and 2012 for guinea pigs, turtles and other reptiles and a decrease for ferrets and rabbits (AVMA 2012). This statistic mentions poultry for the first time in 2012 as well. Consulting animal welfare law, there are restrictions on the private ownership of certain animals. For example, a licence is required in Switzerland for large iguanas, all chameleons, venomous snakes and other reptiles and birds (Swiss Federal Council 2008). Potential owners have to go through a lengthy licencing process before acquiring such an animal; a process that checks husbandry conditions and trains the prospective owner on handling. One could assume that these animals will not be presented often in exotic practice. Checking general census information and legal restrictions only offer a rough estimate of patients that could be expected to turn up at a veterinary practice.

Information from exotic animal clinics or practices on which species they treat, is limited, and very few recent publications are available. The literature is generally more focused on a single species or even on a single disease. A dermatologic study (Hill and Williams 2006) recorded animals seen by 20 veterinary surgeries in the UK. Of the reported consultations, 9% were for exotics. The 2010 Survey of the Royal College of Veterinary Surgeons (Robertson-Smith et al. 2010), however, gives an overview of the estimated working hours per species. In 2006 a positive trend was predicted for rabbits and other exotics, whereas the hours for birds was expected to stay the same. The survey finally found a negative trend for rabbits and birds, but confirmed the positive trend for exotics and other small animals like dogs and cats. For 2005, Vermeulen et al. (2008) reported on the species seen by veterinary practitioners in the Netherlands. The study found a 25% increase for avian and reptile patients seen compared to a similar study analysing 1994 (Lumeij et al. 1998).

Table 1 *Literature on the frequency of exotic pets in veterinary practice*

Source	Material	Main results
Kirschbaum (1994)	Small mammals and reptiles n=792 Clinical patients 1992 to 1993 University of Hannover, Germany	96% Small mammals 4% Reptiles
Fehr (1999)	Exotic pets and wild mammals n=1805 Clinical patients 1998 to 1999 University of Hannover, Germany	85% Small mammals 6% Reptiles
Rheker (2001)	Small animals (dogs, cats, small mammals, birds, reptiles) n=9139 Clinical patients 1990 to1999 University of Hannover, Germany	85% Small mammals 12% Birds 8% Reptiles
Kraft (2005)	Small animals (dogs, cats, small mammals, wild mammals) Clinical patients in 1967, 1987, 1993, 1999, 2002 University of Munich, Gemany	8% Small mammals (+6%)*
Hill and Williams (2006)	Small animals n = 3707 Randomly selected clinical patients surveyed between 1998 and 2001 (undefined exact time period) 20 veterinary practices United Kingdom	9% Exotic pets of which 85% Small mammals 10% Birds 5% Reptiles
Vermeulen et al. (2008)	Various pet species Questionnaire 2005 The Netherlands	13% Exotic pets 25% increase since 1994, doubling of numbers for birds and reptiles
Nielsen et al. (2014)	Various pet species Questionnaire 2011 United Kingdom	Rabbit and guinea pig among 7 most common species in veterinary practice
Langenecker (2006)	Exotic pets n=11833 Clinical patients 1994 to 2003 University of Zurich, Switzerland	50% Small mammals (+12%)* 26% Birds (-10%)* 24% Reptiles (+6%)*

* change of percentages from beginning to end of study period

In summary, the literature agrees that exotic species in general and small mammals in particular are a part of the daily caseload for a small animal practitioner. Within the exotic species, mammals make up the largest part, but birds and reptiles are also seen as patients. Reptiles appear to have increased in recent years.

The following tables 2 to table 11 summarize the literature from different clinics and countries on the most important species and their respective diseases.

3.1 Small mammals

Table 2 *Literature on distribution of small mammal species presented in veterinary practices*

Source	Material	Main results
Kirschbaum (1994)	Small mammals n= 739 Clinical patients 1992 to 1993 University of Hannover, Germany	38% Rabbits 44% Guinea pigs 6% Hamsters[1] 4% Rats
Fehr (1999)	Small mammals n=1543 Clinical patients 1998 to 1999 University of Hannover, Germany	36% Rabbits 28% Guinea pigs 10% Chinchillas[2] 10% Ferrets
Rheker (2001)	Small mammals n=8355 Clinical patients 1990 to 1999 University of Hannover, Germany	49% Rabbits 28% Guinea pigs 6% Chinchillas 6% Rats
Kraft (2005)	Exotic pet mammals and wild mammals Clinical patients in 1967, 1987, 1993, 1999, 2002 University of Munich, Germany	46% Rabbits (+29%)[3] 23% Guinea pigs (-14%)[3] 9% Rats (+8%)[3] 6% Chinchillas (-5%)[3]
Hill and Williams (2006)	n = 266 Clinical patients 1998 to 2001 non-continuous 20 veterinary practices United Kingdom	53% Rabbits 24% Guinea pigs 16% Hamsters 9% Rats
Jekl et al. (2008)	n=590 (rabbits, guinea pigs, chinchillas) Clinical patients with suspicion of dental disease on admission 2002 to 2005 University of Brno, Czech Republic	44% Guinea pigs 36% Rabbits 21% Chinchillas
Langenecker et al. (2009)	Rabbits, guinea pigs, rats, ferrets n=5793 Clinical patients 1994 to 2003 University of Zurich, Switzerland	37% Rabbits (+5%)[3] 35% Guinea pigs (-10%)[3] 11% Rats (+3%)[3] 6% Chinchillas (-5%)[3] 3% Ferrets (+7%)[3]

[1] *Cricetidae* [2] *Chinchilla ssp.*
[3] Change of percentage from beginning to end of study period

3.1.1 Rabbits

Table 3 *Literature on frequently seen diseases in rabbit patients presented in veterinary practices*

Source	Material	Main results
Möller (1984)	n=130 Clinical patients 1981 to 1983 Clinic for small animals, Hanau am Main, Germany	15% Gastrointestinal tract disorders 12% Ophthalmologic disorders 9% Respiratory tract disorders
Kirschbaum (1994)	n=284 Clinical patients 1992 to 1993 University of Hannover and 3 small animal surgeries, Germany	21% Dental disease 10% Overgrown claws 7% Gastrointestinal tract disorders/ ophthalmologic disorders
Fehr (1999)	n=501 Clinical patients 1998 to 1999 University of Hannover, Germany	25% Dental disease 13% Dermatologic disorders 11% Ophthalmologic disorders
Rheker (2001)	n=3356 Clinical patients 1990 to1999 University of Hannover, Germany	17% Dental disease 12% Castration 5% Vaccination
Langenecker et al. (2009)	n=2125 Clinical patients 1994 to 2003 University of Zurich, Switzerland	14% Dental disease 13% Castration 11% Encephalitozoonosis
Snook et al. (2013)	n=1152 Clinical patients 1984 to 2004 University of California, United States	29% Dermatologic disease[1]
Nielsen et al. (2014)	Questionnaire 2011 United Kingdom	30% Dental disease 25% Dermatologic disease 15% Gastrointestinal tract disorders

[1] Only dermatologic disease was researched.

3.1.2 Guinea pigs

Table 4 *Literature on frequently seen diseases in guinea pig patients presented in veterinary practices*

Source	Material	Main results
Möller (1984)	n=140 Clinical patients 1981 to 1983 Clinic for small animals, Hanau, Germany	15% Dental disease 12% Ectoparasites 9% Overgrown claws
Kirschbaum (1994)	n=323 Clinical patients 1992 to 1993 Veterinary practices in Germany	22% Ectoparasites 9% Dental disease 8% Overgrown claws
Fehr (1999)	n=341 Clinical patients 1998 to 1999 University of Hannover, Germany	38% Gastrointestinal tract disorders 20% Dental disease 13% Musculoskeletal disorders
Rheker (2001)	n= 2353 Clinical patients 1990 to1999 University of Hannover, Germany	16% Dental disease 12% Castration 6% Abscess
Langenecker et al. (2009)	n=2009 Clinical patients 1994 to 2003 University of Zurich, Switzerland	14% Yersiniosis 12% Dental disease 10% Castration
Nielsen et al. (2014)	Questionnaire 2011 United Kingdom	38% Dermatologic disorders 18% Dental disease 14% Non-specific disorders
Minarikova et al. (2015)	n=1000 Clinical patients 2008 to 2013 University of Brno, Czech Republic	36% Dental disease 33% Dermatologic disease 22% Ovarian cystic disease
White et al. (2016)	n=580 Clinical patients 1990 to 2015 University of California, United States	50% Dermatologic disease[1]

[1] Only dermatologic disease was researched.

3.1.3 Other small mammals

Table 5 *Literature on frequently seen diseases in other small mammal patients presented in veterinary practices*

Source	Material	Main results
Rats		
Kirschbaum (1994)	n=31 Clinical patients 1992 to 1993 University of Hannover and 3 small animal surgeries, Germany	29% Neoplasia 23% Pneumonia 13% Neurologic disorders
Fehr (1999)	n=109 Clinical patients 1998 to 1999 University of Hannover, Germany	31% Respiratory tract disorders 23% Neoplasia 17% Dermatologic disorders
Rheker (2001)	n=480 Clinical patients 1990 to1999 University of Hannover	26% Pneumonia 21% Neoplasia 15% Castration
Langenecker et al. (2009)	n=651 Clinical patients 1994 to 2003 University of Zurich, Switzerland	34% Neoplasia 13% Pneumonia 8% Abscess
Rey et al. (2015)	n=375 Clinical patients 2013 to 2013 Private practice, France	24% Dermatologic disorders 21% Respiratory tract disorders 15% Reproductive tract disorders
Degus[1]		
Jekl et al. (2011)	n=300 Clinical patients 2007 to 2009 University of Brno, Czech Republic	60% Dental disease 37% Dermatologic disorders 17% Ophthalmologic disorders
Van Bolhuis et al. (2017)	n=224 Clinical patients 2005 to 2015 Rescue Centre Netherlands	34% Dental disease
Chinchillas		
Martino et al. (2016)	n=698 Pathology from ranched animals 1999 to 2013, La Plata University, Argentina	35% Enteritis 28% Pneumonia 6% Trauma

[1] *Octodon degus*

3.2 Birds

Table 6 *Literature on distribution of bird species presented in veterinary practices*

Source	Material	Main results
Korbel et al. (1993)	n=5433 Pathology reports 1988 to 1992 Ludwig Maximilian University Munich, Germany	38% Budgerigars[1] 7% Amazon parrots 7% Grey parrots[2] 4% Cockatiels[3]
Albicker-Rippinger and Hoop (1999)	n=2412 Pathology reports 1991 to 1997 University of Zurich, Switzerland	32% Budgerigars 8% Canaries 7% Amazon parrots 6% Cockatiels
Hill and Williams (2006)	n = 36 Clinical patients 1998 to 2001 non-continuous 20 veterinary practices, United Kingdom	44% Budgerigars 14% Cockatiels 11% Parrots 3% Chickens
Langenecker (2006)	n=3420 Clinical patients 1994 to 2003 University of Zurich, Switzerland	37% Budgerigars (unchanged)[4] 14% Amazon parrots (+4%)[4] 14% Grey parrots (+2%)[4]
Psittaciformes		
Filip and Scope (2002)	n= 1738 Clinical patients 1194 to 2000 University of Vienna, Austria	46% Budgerigars 12% Grey parrots 10% Cockatiels
Diener (2015)	n=1919 Blood samples from clinical patients 2007 to 2013, Ludwig Maximilian University Munich, Germany	39% Budgerigars 23% Grey parrots 12% Amazon parrots 11% Cockatiels

[1] *Melopsittacus undulatus* [2] *Psittacus erithacus*
[3] *Nymphicus hollandicus* [4] Change of percentage from beginning to end of study period

Table 7 *Literature on frequently seen diseases in avian patients presented in veterinary practices*

Source	Material	Main results
Schuetz (2011)	n=1673 Pathology reports 1997 to 2003, University of Giessen, Germany	48% Respiratory tract disorders 40% Dermatologic disorders
Amazon parrots		
Albicker-Rippinger and Hoop (1999)	n=170 Pathology reports 1991 to 1997 University of Zurich, Switzerland	17% Mycosis 17% Atherosclerosis 12% Chlamydiosis
Langenecker (2006)	n=497 Clinical patients 1994 to 2003 University of Zurich, Switzerland	16% Suspected aspergillosis 10% Overgrown claws 7% Suspected hepatic disorders
Grey parrots		
Albicker-Rippinger and Hoop (1999)	n=112 Pathology reports 1991 to 1997 University of Zurich, Switzerland	35% Atherosclerosis 20% Mycosis 9% Macaw wasting disease
Langenecker (2006)	n=465 Clinical patients 1994 to 2003 University of Zurich, Switzerland	23% Suspected aspergillosis 9% Behavioural disorders 8% Overgrown claws
Budgerigars		
Albicker-Rippinger and Hoop (1999)	n=763 Pathology reports 1991 to 1997 University of Zurich, Switzerland	47% Gastrointestinal tract disorders 16% Neoplasia
Langenecker (2006)	n=1137 Clinical patients 1994 to 2003 University of Zurich, Switzerland	28% Neoplasia 14% Gastrointestinal tract disorders 7% Trauma
Cockatiels		
Albicker-Rippinger and Hoop (1999)	n=205 Pathology reports 1991 to 1997 University of Zurich, Switzerland	23% Gastrointestinal tract disorders 12% Pox infection 10% Tracheal mites
Langenecker (2006)	n=234 Clinical patients 1994 to 2003 University of Zurich, Switzerland	12% Neoplasia 11% Trauma 10% Suspected hepatic disorders

3.3 Reptiles

Table 8 *Literature on distribution of reptiles species presented in veterinary practices*

Source	Material	Main results
Scheinert et al. (1992)	n=307 Clinical patients 1984 to 1990 Ludwig Maximilian University Munich, Germany	27% *Testudines* (21% tortoisess) 44% *Serpentes* (7% *Boa constrictor*) 29% *Sauria* (10% green iguanas) (3% Chinese water dragons[1])
Fehr (1999)	n=105 Clinical patients 1998 to 1999 University of Hannover, Germany	50% *Testudines* 17% *Serpentes* 33% *Sauria*
Rheker (2001)	n=770 Clinical patients 1990 to1999 University of Hannover, Germany	61% *Testudines* 8% *Serpentes* (3% ball pythons) 31% *Sauria* (22% green iguanas) (7% bearded dragons)
Sinn (2004)	n=1941 Pathology data 1990 to 2000 Ludwig Maximilian University Munich, Germany	51% *Testudines* (34% tortoises) (17% turtles) 22% *Serpentes* 27% *Sauria* (7% green iguanas) (2% Chinese water dragons) (2% bearded dragons)
Hill and Williams (2006)	n =14 Clinical patients 1998 to 2001 non-continuous 20 veterinary practices, United Kingdom	36% *Testudines* 21% *Serpentes* 42% *Sauria* (21% green iguanas)
Langenecker (2006)	n=2620 Clinical patients 1994 to 2003 University of Zurich, Switzerland	46% *Testudines* (32% tortoises (-9%))* (9% red-eared sliders (+/-))[2] 26% *Serpentes* (7% *Boa constrictor* (+/-))[2] 28% *Sauria* (9% bearded dragons (+7%))[2] (8% green iguanas (+3%))[2]
Pees et al. (2014)	n=304 Questionnaire for clinical patients over 6 months 7 specialised clinics in Germany	44% *Testudines* (37% tortoises) 17% *Serpentes* 39% *Sauria* (21% bearded dragons) (5% veiled chameleons[3])
Lukac et al. (2015)	n=200 Clinical patients 2009 to 2011 University of Zagreb, Croatia	40% *Testudines* 45% *Serpentes* 15% *Sauria*

[1] *Physignathus cocincinus* [2] Change of percentages from beginning to end of study period
[3] *Chamaeleo calyptratus*

3.3.1 Testudines

Table 9 *Literature on frequently seen diseases in Testudines patients presented in veterinary practices*

Source	Material	Main results
Scheinert et al. (1992)	n=84 Clinical patients 1984 to 1990 Ludwig Maximilian University Munich, Germany	28% Pneumonia 13% Nephropathy 8% Parasitosis
Krautwald-Junghanns et al. (2007)	Clinical patients, University of Leipzig, Germany	16% Respiratory tract disorders[1]
Tortoise		
Sinn (2004)*	Reptiles n=1941 Pathology data 1990 to 2000 Ludwig Maximilian University Munich, Germany	80% Urinary tract disorders 50% Hepatic disorders 46% Gastrointestinal tract disorders
Langenecker (2006)	n=844 Clinical patients 1994 to 2003 University of Zurich, Switzerland	25% Endoparasites 14% Trauma 10% Musculoskeletal disorders
Turtle		
Sinn (2004)	Reptiles n=1941 Pathology data 1990 to 2000 Ludwig Maximilian University Munich, Germany	57% Hepatic disorders[2] 50% Urinary tract disorders[2] 45% Respiratory tract disorders[2]
Langenecker (2006)	n=226 Clinical patients 1994 to 2003 University of Zurich, Switzerland	24% Hypovitaminosis A 15% Trauma 10% Pneumonia

[1] Only respiratory tract disorders were researched.
[2] Several diagnoses were possible per animal.

3.3.2 Serpentes

Table 10 *Literature on frequently seen diseases in snake patients presented in veterinary practices*

Source	Material	Main results
Scheinert et al. (1992)	n=135 Clinical patients 1984 to 1990 Ludwig Maximilian University Munich, Germany	28% Pneumonia 13% Nephropathy 13% Septicaemia
Sinn (2004)	Reptiles, n=1941 Pathology data 1990 to 2000 Ludwig Maximilian University Munich, Germany	50% Gastrointestinal tract disorders[1] 47% Respiratory tract disorders[1] 43% Urinary tract disorders[1]
Krautwald-Junghanns et al. (2007)	Clinical patients, University of Leipzig, Germany	24% Respiratory tract disorder[2]
Boa constrictor		
Langenecker (2006)	n=181 Clinical patients 1994 to 2003 University of Zurich, Switzerland	13% Boid inclusion body disease 13% Abscess 13% Pneumonia

[1] Several diagnoses were possible per animal.
[2] Only respiratory tract disorders were researched.

3.3.3 Sauria

Table 11 *Literature on frequently seen diseases in Sauria patients presented in veterinary practices*

Source	Material	Main results
Scheinert et al. (1992)	n=90 Clinical patients 1984 to 1990 Ludwig Maximilian University Munich, Germany	23% Pneumonia 14% Parasitosis 10% Nephropathy
Sinn (2004)	Reptiles n=1941 Pathology data 1990 to 2000 Ludwig Maximilian University Munich, Germany	69% Urinary tract disorders[1] 47% Hepatic disorders[1] 41% Respiratory tract disorders[1]
Krautwald-Junghanns et al. (2007)	Clinical patients, University of Leipzig, Germany	2% Respiratory tract disorder[2]
Green iguanas		
Langenecker (2006)	n=221 Clinical patients 1994 to 2003 University of Zurich, Switzerland	24% Musculoskeletal disorders 15% Trauma 14% Abscess
Bearded dragons		
Langenecker (2006)	n=242 Clinical patients 1994 to 2003 University of Zurich, Switzerland	26% Endoparasites 19% Musculoskeletal disorders 14% Trauma
Schmidt-Ukaj et al. (2017)	n=529 Clinical patients over three years Exotic practice in central Europe	43% Gastrointestinal and hepatic disorders 22% Dermatologic disease 19% Musculoskeletal disorders

[1] Several diagnoses were possible per animal.
[2] Only respiratory tract disorders were researched.

4 MATERIAL AND METHODS

4.1 Material

Records of privately-owned pets that were presented at Clinic for Zoo Animals, Exotic Pets and Wildlife between 2005 to 2014 were investigated. The following animals were excluded from further analysis to avoid distortion of the results: animals belonging to the clinic itself, laboratory animals, animals from privately or publicly owned zoological collections, animals confiscated by the authorities and escaped animals.

4.2 Methods

On the basis of handwritten (2005 to 2013) and digital (2013 to 2014) patient records a database containing every consultation was assembled in Microsoft® Excel 2017. To manage the extensive amount of information, the following criteria for each consultation were extracted and coded if possible. The individual criteria as well as the coding and a short description are given in tables 12-17.

4.2.1 Identity

Table 12 *Criteria for identity*

Criteria	Description	
ID	Patient ID number given by the clinic filing system	
Month of birth	Month and year of birth	
	If month was unknown, January was assigned as month of birth.	
Species	Binominal name	
	If the species was not specified i.e. snake, tortoise, the animals were listed systematically as precisely as possible.	
Gender	1 Male 2 Female 3 Undetermined	4 Male castrated 5 Female castrated
	Animals without external sexual dimorphisms i.e. parrots or snakes were classified to the owner's best knowledge or else as undetermined.	

4.2.2 Consultation

Table 13 *Criteria for consultation*

Criteria	Description	
Date	Date of consultation	
Season	1 Winter: December, January, February 2 Spring: March, April, May	3 Summer: June, July, August 4 Autumn: September, October, November
Counter	Showing how many times the animal has been presented to the clinic – with the same or a different complaint.	
Age [years]	Age at time of consultation; for age analysis, the animals were divided into juvenile, adult and senior (depending on sexual maturity and clinically relevant onset of old age)	
Emergency	0 Scheduled consultation	1 Emergency consultation
Hospitalisation	0 Outpatient	1 Inpatient
Referral	0 No referral	1 Referral
Population problem	0 Individual problem	1 Population problem
Presenting complaint	Maximum of 3 different entries as given by the owner. If consultation was a follow-up, the presenting complaint was "control".	

4.2.3 Clinical exam

Table 14 *Criteria for clinical exam*

Criteria	Description	
General condition	1 normal 2 moderately depressed	3 severely depressed 4 dead
Body condition score	1 severely reduced 2 moderately reduced	3 normal 4 overweight
Clinical findings	Key findings from the clinical examination were recorded.	
Weight [grams]	Body weight at day of presentation	

4.2.4 Diagnostic methods and diagnosis

Table 15 *Criteria for diagnostic methods and diagnosis*

Criteria	Description
Methods	A maximum of 4 diagnostic methods could be entered.
Diagnosis	A maximum of 3 diagnoses could be given. Diagnoses were grouped whenever possible by affected organ system.
	The term “diagnosis” is used loosely. It was not always possible to distinguish between a definitive or tentative diagnosis.

4.2.5 Treatment

Table 16 *Criteria for treatment*

Criteria	Description	
Medication	A maximum of 4 different medications were recorded.	
	If more than 4 medications were given, the medications were limited to those most important for treatment.	
Supportive treatment	Supportive treatment, e.g. fluid therapy, force feeding, bathing etc. was recorded separately. A maximum of 3 supportive treatment options could be given.	
Anaesthesia	0 No anaesthesia	1 Anaesthesia
	Anaesthesia was recorded regardless of whether it was for diagnostic or curative purposes.	
Intervention	A maximum of 2 interventions was recorded.	

4.2.6 Outcome

Table 17 *Criteria for outcome*

Criteria	Description	
Duration of stay	The duration of stay was recorded in days. If the animal was presented for an outpatient consultation, the duration of stay was 1.	
Outcome	1 Discharge without medication 2 Discharge with medication 3 Died during stay	4 Euthanized 5 Unknown
Necropsy	0 Animal discharged or no necropsy performed 1 Necropsy performed	

4.3 Analysis

The data was analysed with descriptive statistics using Microsoft® Excel, Version15.37, Zurich, Switzerland. To evaluate changes over the length of the study period, linear regression analysis was performed using the same software. Values of $p \leq 0.05$ were considered significant. Each species is introduced with a short summary of the most common patient as it could be extracted from the dataset.

5 RESULTS

Between 2005 and 2014, a total number of 9198 animals were presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife. A total of 232 patients were excluded from the analysis because the animals were either confiscated by the veterinary authorities, an experimental animal or from a private zoological collection. Escaped pet animals (n=143) were excluded as well. Fish, amphibians and invertebrates were presented 58 times and not investigated any further. The presentation of these animals amounted to 15189 consultations (Tab. 18). Between 2005 to 2014 the number of consultations decreased significantly ($p<0.01$). This decrease did not affect the consultations for mammals but mostly these for birds and especially those for reptiles. From 2005 to 2014, mammals made up 54% of all patients, while birds and reptiles amounted to 21% and 24% respectively (Fig. 1).

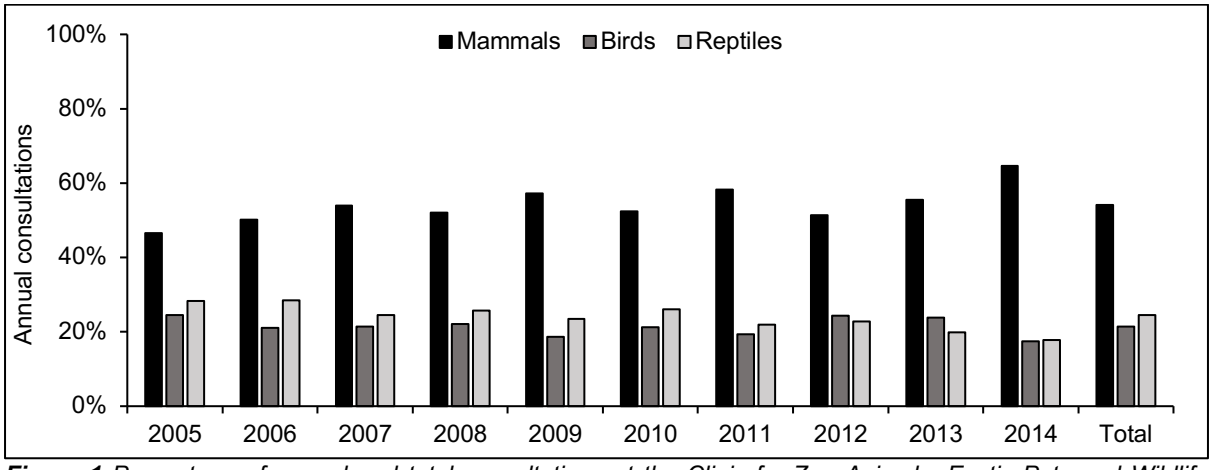

Figure 1 *Percentage of annual and total consultations at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 and 2014*

Table 18 *Absolute number of consultations at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 and 2014 as well as total numbers*

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Total	1858	1756	1609	1720	1897	1570	1336	1109	1164	1240	15189
Mammals	866	882	867	895	1085	823	779	569	646	802	8214
Birds	456	371	344	379	355	334	258	270	278	216	3261
Reptiles	529	501	395	442	444	408	294	252	231	220	3714

5.1.1 Consultations

5.1.1.1 Emergency consultations

The number of animals presented as emergencies either during or outside of office hours was 4461 (29% of all consultations). Mammals made up 55% of all emergency consultations, birds 25% and reptiles 20%. More than half of new patients were presented as emergencies (Fig. 3). Emergency consultations for new patients increased across all classes ($p<0.01$).

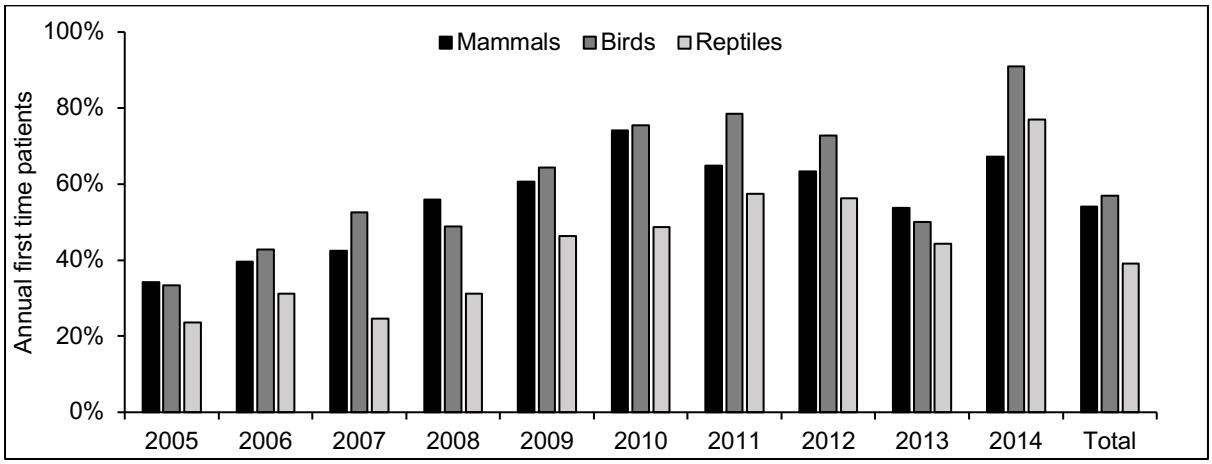

Figure 2 *Percentage of emergency consultations for first time patients at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland); peak in 2014 partly due to decrease in percentage of first-time consultations (Fig.4)*

5.1.1.2 Referrals

On average, 4% of all consultations were referrals. For first time patients, the percentage is a little higher with 6%. The referral rate for new patients varied between 8% for mammals, 7% for birds and 5% for reptiles and did not change during the observed period.

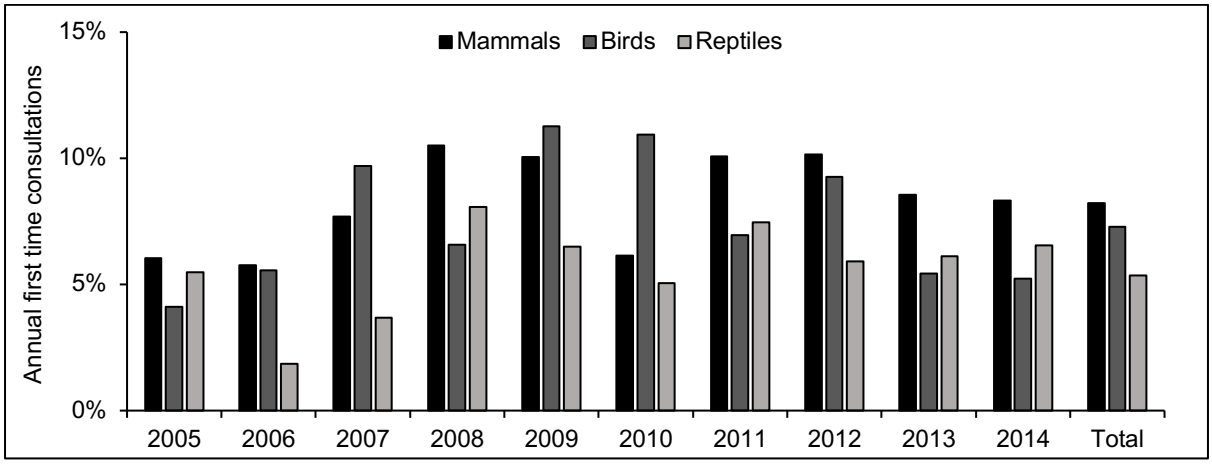

Figure 3 *Percentage of referrals for first time consultations at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland)*

5.1.1.3 Population problems

Consultations for population problems amounted to 10%. For reptiles, the percentage was significantly higher than for mammals and birds (22% vs. 6%; $p<0.01$). Reptiles also showed a significant decrease of population problems from 24% in 2005 to 10% in 2014 ($p<0.01$).

5.1.1.4 Repeated consultations

Over all consultations, 58% of the animals were presented for the first time (Fig. 2), 28% were presented for the 2nd to 4th time and 14% were presented for the 5th or more visit. The percentage of patients that were presented more than 4 times increased significantly ($p<0.01$) from 9% in 2006 to 18% in 2014. Archiving might have had an influence on the numbers from 2005.

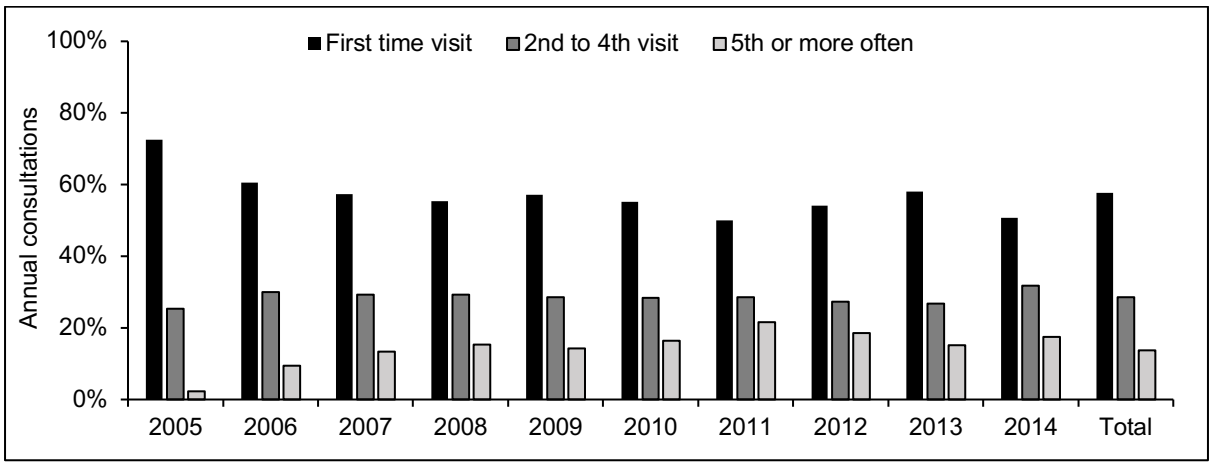

Figure 4 *Percentage of first-time visits, 2nd to 4th visits, and 5th or more visits for animals presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland)*

5.1.2 Outcome

5.1.2.1 Inpatient admission

Animals were hospitalised for at least one day after 31% of all consultations. This percentage did not change significantly over the years. Birds were more likely to be hospitalised than mammals (36% vs. 29%; Fig. 5). Inpatient admission increased significantly for mammals ($p<0.01$) and for birds, but decreased for reptiles (data not shown).

5.1.2.2 Length of stay

Hospitalisation lasted one day in 7%, 2-4 days in 63% and 5 or more days in 30% of cases. Over the evaluated period there was a significant decrease of animals admitted for 5 or more days ($p<0.01$), and a significant increase for a shorter stay ($p<0.01$; data not shown). Analysed by class, mammals were most often treated as outpatients, whereas birds and reptiles were more likely to be hospitalised (Fig. 5).

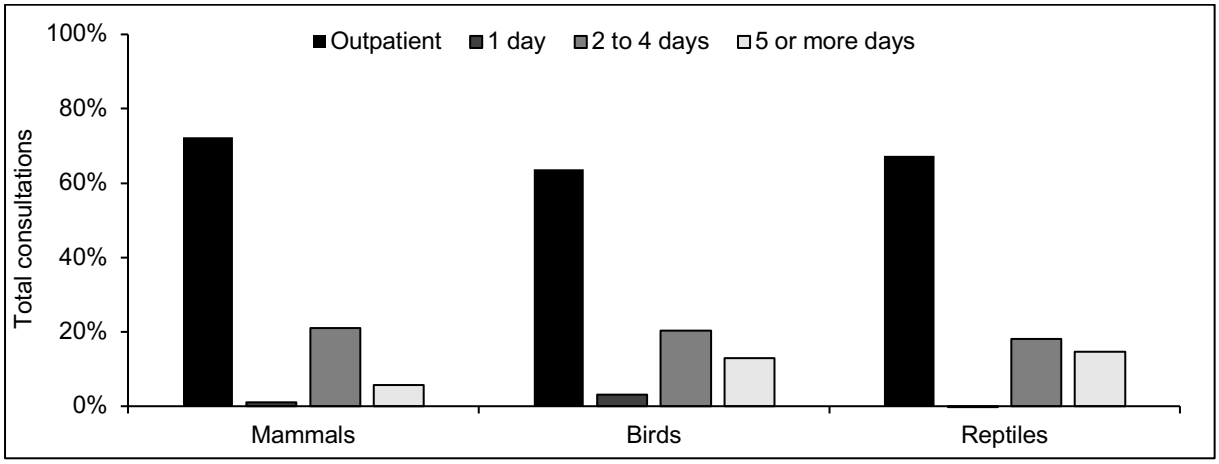

Figure 5 *Length of stay in days for patients at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) from 2005 and 2014*

5.1.2.3 Discharge

After 84% of all animals could be discharged; 40% without medication and 60% with medication. The remaining 16% were either euthanized (69%) or died during their stay (31%). Over the 10-year study period, the share of animals that were discharged without medication decreased significantly ($p<0.01$), while discharge with medication increased significantly ($p<0.01$; data not shown). Reptiles were the only class where more animals were discharged without medication (Fig. 6). The ratio of animals that died on their own versus those that were euthanized during their stay was 1:3 for mammals and reptiles but almost 1:1 for birds (data not shown).

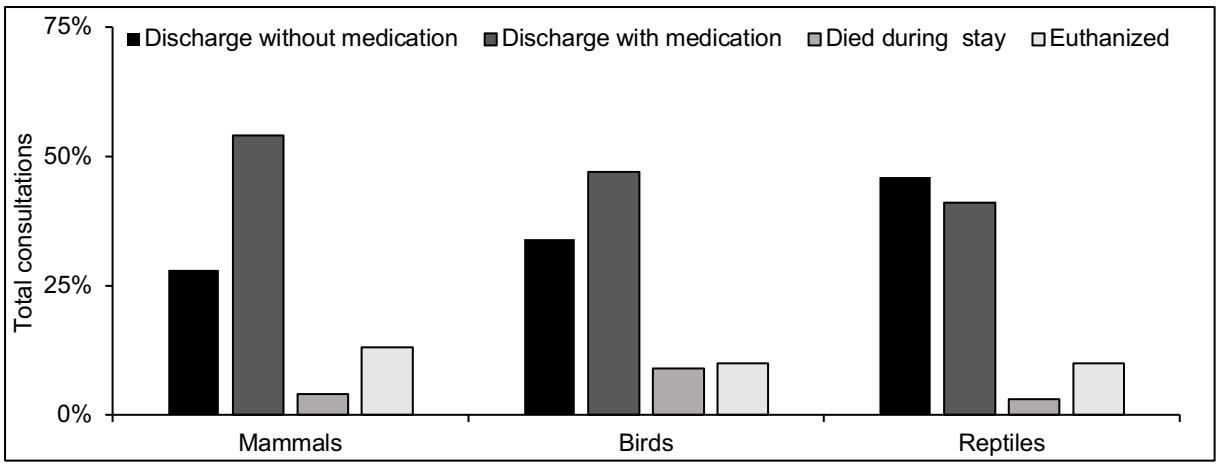

Figure 6 *Outcome for animals presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 and 2014*

A post-mortem exam is conditional on the owner's permission. Birds had the highest percentage of requested necropsies with 40%, followed by reptiles with 32% and mammals with only 15% (Fig. 7).

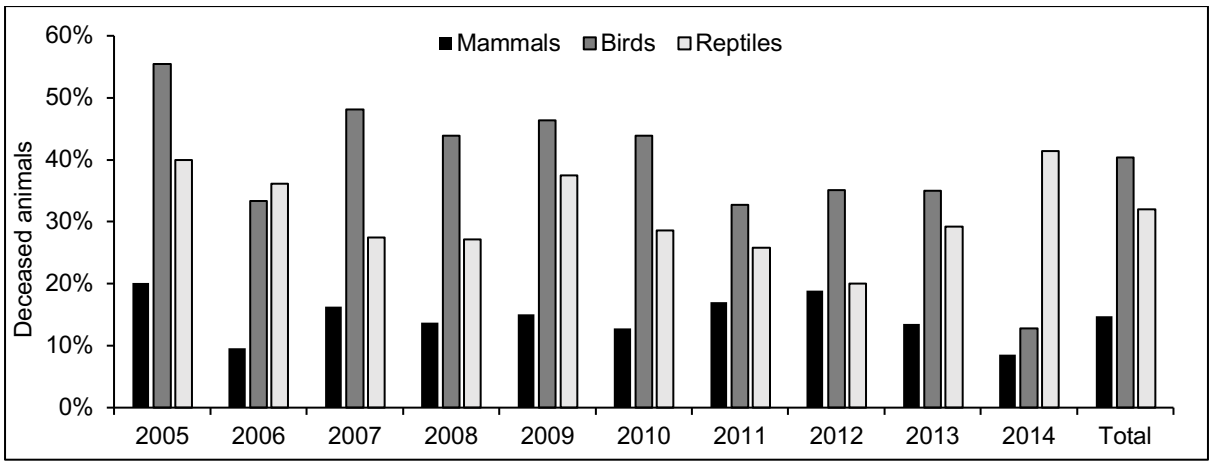

Figure 7 *Post-mortem diagnostics for deceased (euthanized or died during stay) animals at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 and 2014*

5.2 Mammals

5.2.1 Mammal orders

Over the analysed time period, 8214 consultations for mammals were held. The order of *Rodentia* made up the main share with 57%, followed by *Lagomorpha* with 37%, *Carnivora* 4% and other *Mammalia* 2%. *Rodentia* increased significantly over the observed time period ($p<0.03$), whereas *Lagomorpha* and *Carnivora* decreased significantly ($p<0.03$ and $p<0.02$ respectively). More than half the mammalian emergencies were for *Rodentia* (56%). *Lagomorpha* came second at 40%.

5.2.2 Mammal species

During the study period a variety of species were presented at the clinic (Tab. 19). Rabbits were the most frequently presented animals, followed by the rodent species guinea pig, rat, chinchilla and hamster (Tab.20). Although ferret consultations declined over time, they still represented 4% of all consultations. Over the years there was a significant negative trend for the percentage of rabbits ($p<0.03$) and ferrets ($p<0.01$). Meanwhile the share for hamsters increased significantly ($p<0.02$).

Table 19 *Mammalian species presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 and 2014*

Order	Species
Lagomorpha	Rabbit *Oryctolagus cuniculus*
Rodentia	Guinea pig *Cavia porcellus,* chinchilla *Chinchillidae,* hamster *Cricetidae,* rat *Rattus norvegicus,* gerbil *Gerbillinae*, degu *Octodon degus*, mouse *Muridae ssp.*, old world porcupine *Hystricidae*, chipmunk *Tamias ssp.*, steppe lemming *Lagurus lagurus*, marmot *Marmota ssp.*, Asiatic striped squirrel *Tamiops ssp.*, Gambian pouched rat *Cricetomys gambianus*
Carnivora	Ferret *Mustela putorius furo*, cheetah *Acinonyx jubatus,* racoon *Procyon lotor,* skunk *Mephitidae ssp.,* snow leopard *Panthera unica,* kinkajou *Potos flavus*
Other Mammalia	Marmosets *Callithrix ssp.,* African pygmy hedgehog *Atelerix albiventris,* wallaby *Macropodidae ssp.,* tenrec *Tenrecidae ssp.*

Table 20 *Percentages per species of total yearly consultations for small mammals presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 1994 to 2003 (Langenecker 2006) and 2005 to 2014*

	1994 to 2003	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2005 to 2014
Rabbit	37%	39%	39%	39%	46%	40%	35%	37%	36%	26%	31%	37%
Guinea pig	35%	27%	28%	27%	23%	22%	26%	25%	27%	30%	32%	26%
Rat	11%	13%	10%	7%	7%	8%	14%	14%	10%	14%	13%	11%
Chinchilla	6%	5%	6%	6%	6%	6%	4%	8%	5%	6%	5%	6%
Hamster	5%	4%	3%	4%	3%	5%	8%	6%	5%	7%	6%	5%
Ferret	3%	5%	5%	4%	6%	5%	3%	5%	2%	2%	0%	4%
Degu	-	3%	4%	4%	2%	4%	4%	2%	5%	4%	1%	3%
Gerbil	-	2%	1%	3%	2%	4%	1%	1%	3%	4%	6%	3%
Mouse	-	1%	1%	3%	0%	2%	2%	1%	4%	1%	0%	2%
Others	3%	2%	2%	3%	3%	3%	4%	2%	4%	6%	5%	3%

5.2.3 Rabbits *Oryctolagus cuniculus*

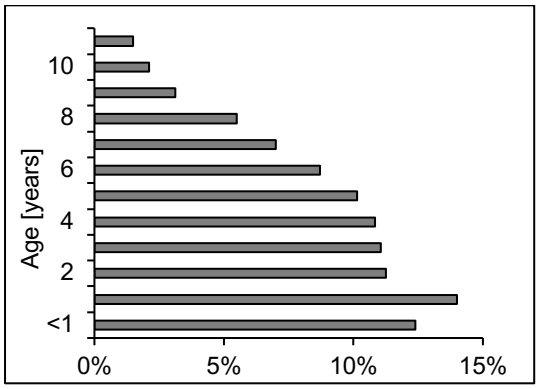

Figure 8 *Age distribution for rabbits presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

Rabbits were the most common species with 20% of consultations and 37% of all mammal consultations (Tab.20). The reason for presentation was a follow-up consultation for 22%; for the other animals, the predominant presenting complaints were anorexia (10%), dental check (7%), respiratory signs (7%) and apathy (6%). Emergency consultations were above all for gastrointestinal tract disorders (29%), trauma (20%) or encephalitozoonosis (17%). Referrals were for gastrointestinal tract disorder (28%), dental disease (19%) and encephalitozoonosis (12%). Dental disease was the most common presumptive diagnosis. Refer to table 21 for the 10 most prevalent diagnoses for rabbit patients.

Table 21 *The top 10 presumptive diagnoses for rabbits presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 1994 to 2003 (Langenecker 2006) and 2005 to 2014 (>1 diagnosis per consultation possible; for previous study only percentage of most prevalent disorders were available)*

Presumptive disorder	Examples of diagnosis	1994 to 2003	2005 to 2014
Dental disease	Elongation of teeth, malocclusion, alveolar periostitis	14%	23%
Gastrointestinal tract disease	Enteritis, ileus, gastric dilation, tympany, endoparasites	-	15%
Trauma	Fracture, bite wound, soft-tissue trauma	13%	13%
Encephalitozoonosis		11%	12%
Respiratory tract disorder	Pneumonia, rhinitis, neoplasia	3%	12%
Dermatologic disorder	Dermatitis, dermatophytosis, pododermatitis, ectoparasites	-	11%
Clinically healthy	Castration, vaccination, health check	13%	11%
Ophthalmologic disorder	Dacrocystitis, conjunctivitis, ulcer, keratitis	7%	8%
Reproductive tract disorder	Metropathy, uterine neoplasia, hyperestrogenism	-	6%
Urinary tract disorder	Nephropathy, urolithiasis, cystitis	3%	4%

Diagnosis with dental disease increased significantly from 16% in 2005 to 35% in 2012 ($p>0.01$) but decreased again in the following years to 16% in 2014 (Fig. 10). The percentage for gastrointestinal tract disorders was stable over the years, whereas for trauma patients there was a drop in 2006 (8%) and 2007 (6%). The percentage of animals with encephalitozoonosis was always between 7% (2014) and 15%.

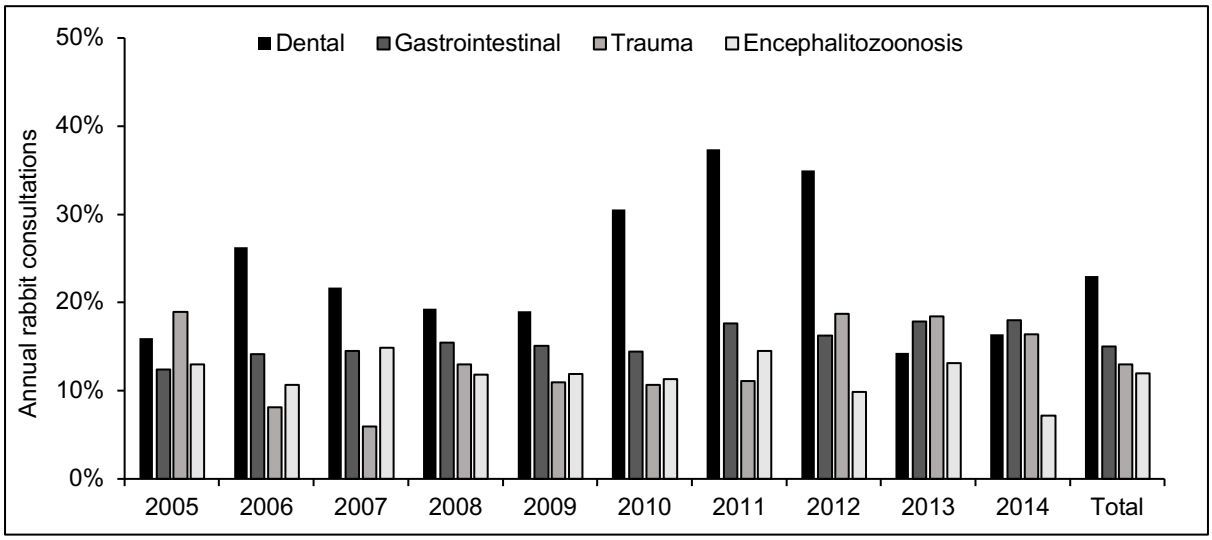

Figure 9 *Percentage of the top 4 presumptive diagnoses for rabbits presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

Table 22 shows a summary of the recorded criteria for all consultations and for those that concluded with of the 4 most common diagnoses. In general, significantly ($p<0.01$) more males than females were presented. For dental disease, this trend is even stronger. Animals less than one year old were most often diagnosed with trauma (19%) unless they were presented for castration (22%). Patients with dental disease showed more repeat consultations, but the animals were not often presented as an emergency. Not even the trauma patients were presented the most common emergency, but animals with gastrointestinal tract disorder. Those also had the highest referral rate and the highest percentage of in-patient admission.

Animals with dental disease were the fastest to be discharged. 77% were discharged after less than one day (74% directly after the consultation). Patients with encephalitozoonosis tended to stay more often for 5 days or more. Success rate was highest in animals with dental disease (89%) and trauma (85%) and lowest in those with gastrointestinal tract disorder (76%). In this diagnosis group, there was also the highest rate of animals that died during their stay (12%).

5.2.3.1 Consultations for rabbits

Table 22 *Evaluation of all consultations and the top 4 presumptive diagnoses for rabbits presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014 (% refer to % of all consultations or % of consultations with the specific diagnosis)*

	All consultations	Dental disease	Gastrointestinal tract disorder	Trauma	Encephalitozoonosis
n	3074	714	471	387	367
♂ ♀	58% 39%	72% 27%	54% 43%	59% 38%	62% 36%
Age [years]					
< 1 ≥1, <5 ≥5	20% 43% 37%	6% 49% 45%	15% 50% 35%	31% 40% 29%	10% 49% 41%
Consultation					
First time ≥5th time	49% 21%	31% 38%	60% 15%	53% 13%	59% 8%
Emergency	32%	21%	59%	50%	44%
In-patient	32%	26%	59%	36%	46%
Referral	6%	5%	11%	5%	6%
Diagnosis					
Diagnostic methods (max. 3 methods per patient)	bloodwork 65% radiography 23%	radiography 20% CT 4%	radiography 49% bloodwork 26% ultrasound 14%	radiography 31%	serology 47% bloodwork 53%
Presumptive diagnosis	-	tooth anomaly 73% tooth an. with abscess 11%	stasis 19% endoparasites 18% enteritis[1] 17%	unspecific injury 22% fracture 14% bite wound 5%	encephalitozoon complex 72% recurrence 10%
Follow-up	-	15%	9%	31%	18%
Treatment					
Antibiotics	enrofloxacin 26% marbofloxacin 3%	enrofloxacin 25%	enrofloxacin 31%	enrofloxacin 34%	enrofloxacin 33%
Analgesia / anti-inflammatory	meloxicam 38% carprofen 8% butorphanol 5%	meloxicam 51% butorphanol 10%	meloxicam 44%	meloxicam 52% buprenorphine 12%	meloxicam 22% dexamethasone 28% prednisolone 2%
Other	fluid supplementation 31% force feeding 17%	force feeding 20%	anti-parasitic 25%	fluid supplementation 28%	fenbendazole 59% vitamin B 7%
Intervention	anaesthesia 35%	tooth correction 61% abscess treatment 7% tooth extraction 1%	laparotomy 2% tooth correction 9%	wound treatment 33% surgery 6%	
Length of stay [days]					
1 >1,≤4 ≥5	70% 22% 8%	77% 17% 6%	45% 44% 11%	66% 26% 8%	55% 29% 16%
Outcome (1 discharge without medication, 2 discharge with medication, 3 died during stay, 4 euthanasia)					
1 2	28% 58%	24% 65%	11% 65%	21% 64%	11% 71%
3 4	4% 10%	2% 9%	12% 12%	2% 13%	5% 13%

[1] unknown aetiology

5.2.4 Guinea pigs *Cavia porcellus*

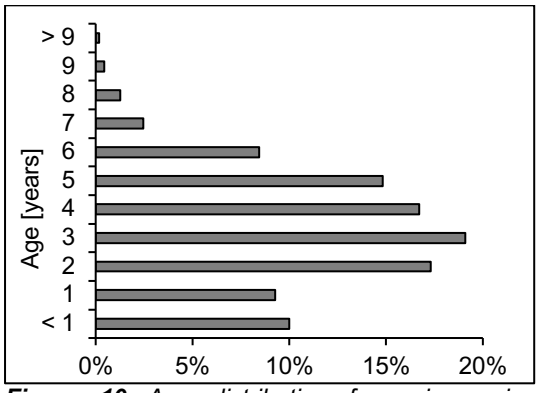

Figure 10 *Age distribution for guinea pigs presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

26% of all mammal consultations were for guinea pigs (Tab. 20). The reasons for presentation were follow-up consultations (26%), anorexia (10%), dental problems (7%), urine changes (6%), castration (5%) and others. Emergency consultations were mainly for gastrointestinal tract disorders (20%), dental disease (18%), respiratory tract disorders (15%) and urinary tract disorders (11%). Common causes for a referral were dental disease (24%), urinary tract disorder (21%) and reproductive tract disorders (17%). Dental disease was the most common presumptive diagnosis, but just as often animals were diagnosed with a dermatologic disorder. Refer to table 23 for the 10 most prevalent diagnosis for guinea pig patients.

Table 23 *The top 10 presumptive diagnoses for guinea pigs presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 1994 to 2003 (Langenecker 2006) and 2005 to 2014 (>1 diagnosis per consultation possible; for previous study only percentage of most prevalent disorders were available)*

Presumptive disorder	Example of diagnosis	1994 to 2003	2005 to 2014
Dental disease	Elongation of teeth, malocclusion, alveolar periostitis	12%	22%
Dermatologic disorder	Pododermatitis, dermatitis, neoplasia	-	22%
Urinary tract disorder	Urolithiasis, cystitis, nephropathy	5%	12%
Reproductive tract disorder	Ovarian cyst, neoplasia, metropathy	3%	11%
Respiratory tract disorder	Pneumonia, rhinitis, bronchitis, pharyngitis, neoplasia	-	9%
Gastrointestinal disorder	Tympany, obstipation, enteritis, stasis, stomatitis	-	9%
Clinically healthy	Castration, health check	10%	9%
Ophthalmologic disorder	Corneal lesions, conjunctivitis, retro-bulbar abscess	5%	8%
Trauma	Fracture, soft tissue trauma, bite wound	4%	4%
Endocrine disorder	Hyperthyroidism, hyperadrenocorticism	-	3%

Dental disease in guinea pigs showed a peak in 2010 with 33% (Fig. 11). For urinary tract disorders, there was a significant increase in consultations from 2011 to 2014 ($p<0.01$). Consultations for reproductive tract disorder showed a peak in 2012 but were between 6% and 11% for the rest of the study period.

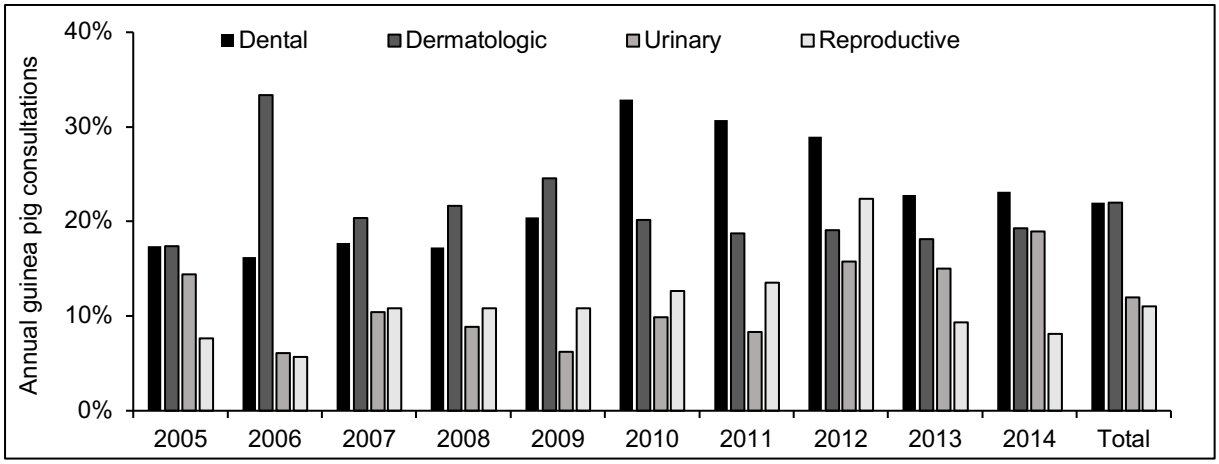

Figure 11 *Percentage of the top 4 presumptive diagnoses for guinea pigs presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

Gender distribution was unremarkable for dermatologic and urinary disorders; animals with dental disease, however, were 61% males, and those with reproductive tract disorder were 93% females. Only 10% of guinea pig patients were less than 1 year old and 37% of these were presented for castration, another 15% had a dermatologic disorder. Animals with dental disease or reproductive tract disorder were presented 4 times more frequently than those with dermatologic or urinary tract disorders. Dermatologic disorders were the least important of the 4-top diagnoses for emergency consultations and inpatient admission. Inverse to animals with urinary tract disorders, which were presented as emergencies for 29% of all urinary tract patients and 38% of animals were admitted to the hospital after their consultation. Referral rate was highest for urinary and reproductive tract disorder.

The majority (82%) of guinea pigs with dermatologic disease were discharged after less than a day. Compared to the rabbits, less animals stayed more than 5 days (8% for rabbits, 5% for guinea pigs). The success rate for guinea pigs was lower than in rabbits (86% for rabbits, 82% for guinea pigs). Guinea pigs with urinary tract disorder had a higher euthanasia rate compared to all consultations (18% vs. 13%).

5.2.4.1 Consultations for guinea pigs

Table 24 *Evaluation of all consultations and the top 4 presumptive diagnoses for guinea pigs presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014 (% refer to % of all consultations or % of consultations with the specific diagnosis)*

	All consultations	Dental disease	Dermatologic disorder	Urinary tract disorder	Reproductive tract disorder
n	2165	483	466	245	231
♂ / ♀	47% / 51%	61% / 38%	40% / 58%	41% / 59%	7% / 93%
Age [years]					
< 1 / ≥1, <5 / ≥5	10% / 62% / 28%	1% / 70% / 29%	8% / 66% / 26%	3% / 62% / 35%	2% / 60% / 37%
Consultation					
First time / ≥5th time	55% / 14%	41% / 27%	48% / 15%	49% / 12%	40% / 26%
Emergency	28%	23%	15%	29%	20%
In-patient	27%	28%	18%	38%	23%
Referral	6%	6%	4%	11%	9%
Diagnosis					
Diagnostic methods (max. 3 methods per patient)	radiography 21% bloodwork 11% ultrasound 10%	radiography 21% CT 6%	cytological test 11% scotch tape 9% fungal culture 5%	radiography 49% ultrasound 40% Combur-Test® 16%	ultrasound 31% radiography 15% bloodwork 12%
Presumptive diagnosis	-	dental disease 67% dental abnormality with abscess formation 12%	ectoparasites 26% pododermatitis 19% suspected neoplasia 8%	urolithiasis 43% cystitis 27% nephropathy 10%	ovarian cyst 27% neoplasia 19% other metropathies 10%
Follow-up	-	20%	31%	19%	37%
Treatment					
Antibiotics	enrofloxacin 30% trimethoprim-sulphonamide 3%	enrofloxacin 34% trimethoprim-sulphonamide 5%	enrofloxacin 22% marbofloxacin 2%	enrofloxacin 36% trimethoprim-sulphonamide 11%	enrofloxacin 29%
Analgesia / anti-inflammatory	meloxicam 44% carprofen 7%	meloxicam 68% butorphanol 10%	meloxicam 36% butorphanol 6%	meloxicam 58% butorphanol 8%	meloxicam 38% butorphanol 8%
Other	vitamin C 19% fluid supplementation 33%	vitamin C 35%	ivermectin 26% selamectin 10%	vitamin C 10% fluid supplementation 48%	human chorionic gonadotropin 36%
Intervention	anaesthesia 31%	tooth correction 57% abscess treatment 10%	surgery 21%	cystostomy 12% urethral flushing 5%	laparotomy 11%
Length of stay [days]					
1 / >1,≤4 / ≥5	74% / 21% / 5%	71% / 22% / 7%	82% / 13% / 6%	63% / 36% / 1%	75% / 21% / 4%
Outcome (1 discharge without medication, 2 discharge with medication, 3 died during stay, 4 euthanasia)					
1 / 2	29% / 53%	11% / 72%	43% / 50%	14% / 64%	42% / 41%
3 / 4	5% / 13%	3% / 14%	2% / 5%	4% / 18%	2% / 14%

5.2.5 Rats *Rattus norvegicus*

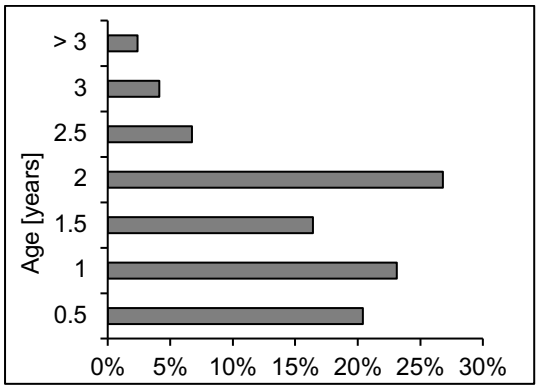

Figure 12 *Age distribution for rats presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

Rats were the third most common species of mammals with 11% (Tab. 20). Space occupying lesion were the reason for 17% of all presentation, respiratory problems for 15% and castration for 10%; follow up consultations for 18%. Animals presented in emergency services were mainly diagnosed with respiratory tract disorder (33%), reproductive tract disorder (19%) or trauma (14%). Only 1% of rats were referred to the clinic, the lowest rate for any other small mammal species (chinchilla 5%, hamster 3%, ferret 5%, gerbil 3%, degu 6%). Respiratory tract disorder was the most common presumptive diagnosis for rats (Tab. 25). Because the fourth most common diagnosis was clinically healthy animals, neurologic disorders were analysed as the fourth most common clinical pathology in table 26.

Table 25 *The top 10 presumptive diagnoses for rats presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 1994 to 2003 (Langenecker 2006) and 2005 to 2014 (>1 diagnosis per consultation possible; for previous study only percentage of most prevalent disorders were available)*

Presumptive disorder	Example of diagnosis	1994 to 2003	2005 to 2014
Respiratory tract disorder	Rhinitis, pneumonia, neoplasia	19%	27%
Reproductive tract disorder	Mammary gland neoplasia, metropathy, dystocia	27%	22%
Dermatologic disease	Ectoparasites, pododermatitis	6%	18%
Clinically healthy	Castration, health check, gender determination	6%	12%
Neurologic disorder	Encephalitis, paresis, otitis	-	8%
Trauma	Fracture, bite wound, polytrauma	-	6%
Lymphatic system disorder	Lymphoma	-	4%
Dental disease	Malocclusion, overgrowth	-	4%
Unknown	No diagnosis due to very poor general condition	-	3%
BCS[1] disorder	Obesity, cachexia	-	3%

[1] Body condition score

In 2007 and 2008 there was an accumulation of rats that were diagnosed with respiratory tract disorder (Fig. 13). After these two years, it decreased significantly to 20% in 2013 and 31% in 2014 ($p<0.02$). Reproductive tract disorders were a common diagnosis in the first three years, but decreased afterwards to 19%. There was also a significant decrease for dermatologic disorders over the whole study period ($p<0.05$). The percentage of neurologic disorder showed no remarkable changes.

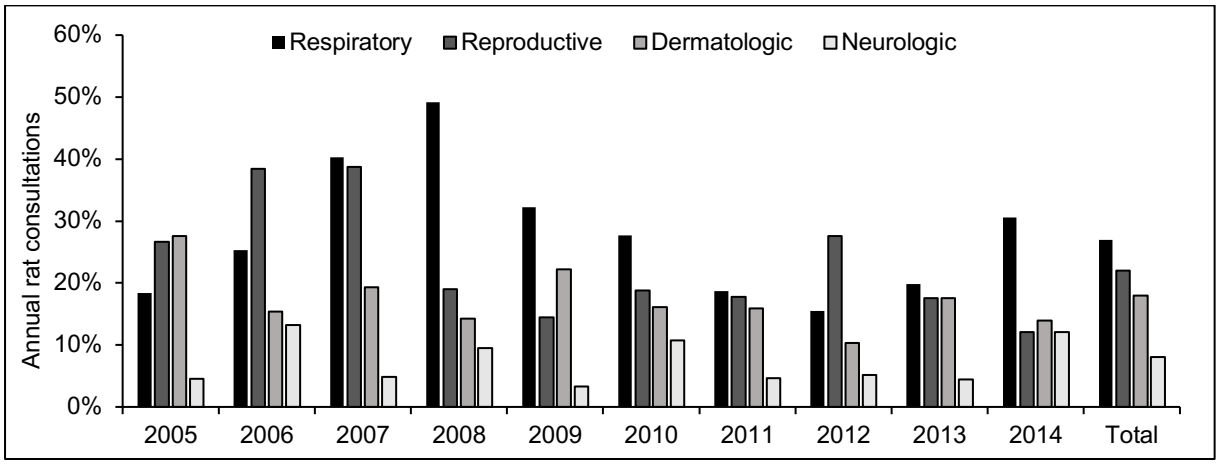

Figure 13 *Percentage of the top 4 presumptive diagnoses for rats presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

Gender distribution of the presented rats diverged from other species, which were more equally distributed (Tab. 26). Especially in reproductive and neurologic disorders, the females were affected more often. Age classes had about the same shares; one rat was believed to be 12 years old, according to the owner. Rats in general had a high rate of first-time consultations with 61% (guinea pig 55%, rabbits 49%). The rate for emergency consultations was highest for neurologic disorders, which also had almost the most in-patient admissions.

Rats were typically discharged after 1 day (78%) or after less than 4 days (19%). Successful discharge rate was over 80% for rabbits and guinea pigs, and 78% for rats. The lowest rate was in neurologic disorders, of which only 64% of animals could be discharged after their consultations and 34% were euthanized.

5.2.5.1 Consultations for rats

Table 26 *Evaluation of all consultations and the top 4 presumptive diagnoses for rats presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014 (% refer to % of all consultations or % of consultations with the specific diagnosis)*

	All consultations	Respiratory tract disorder	Reproductive tract disorder	Dermatologic disease	Neurologic disorder
n	891	239	198	157	67
♂ ♀	30% 64%	29% 65%	11% 89%	25% 67%	18% 75%
Age [years]					
< 1 ≥1, <2 ≥2	30% 43% 27%	28% 49% 23%	13% 48% 39%	22% 46% 32%	27% 42% 31%
Consultation					
First time ≥5th time	61% 7%	64% 2%	54% 10%	50% 6%	49% 1%
Emergency	26%	32%	22%	10%	43%
In-patient	22%	27%	32%	10%	31%
Referral	1%	1%	1%	1%	4%
Diagnosis					
Diagnostic methods (max. 3 methods per patient)	radiography 7% ultrasound 3% bloodwork 1%	radiography 10% computer tomography 1%	fine needle aspiration 5% biopsy 5% ultrasound 5%	scotch tape 30% bloodwork 1%	radiography 9% computer tomography 1%
Presumptive diagnosis	-	rhinitis 47% pneumonia 36%	mammary gland neoplasia 51% other neoplasia 14%	ectoparasites 46% sebaceous cyst 15% neoplasia 8%	otitis 36% encephalitis 24% neoplasia 10%
Follow-up	-	13%	21%	25%	16%
Treatment					
Antibiotics	enrofloxacin 33% azithromycin 14% tylosin 9%	enrofloxacin 46% azithromycin 41% tylosin 28%	enrofloxacin 40%	enrofloxacin 21% metronidazole 1%	enrofloxacin 36% azithromycin 19% tylosin 22%
Analgesia / anti-inflammatory	meloxicam 40% carprofen 6%	meloxicam 34% carprofen 2%	meloxicam 45% carprofen 18%	meloxicam 24% butorphanol 4%	meloxicam 34% dexamethasone 7%
Other	fluid supplementation 22%	acetylcysteine 6%	vitamin K 3%	selamectin 28% ivermectin 27%	vitamin B 7%
Intervention	anaesthesia 30%	inhalation therapy 6%	surgery 38%	surgery 15%	-
Length of stay [days]					
1 >1,≤4 ≥5	78% 19% 3%	73% 22% 5%	67% 30% 3%	89% 8% 3%	72% 24% 4%
Outcome (1 discharge without medication, 2 discharge with medication, 3 died during stay, 4 euthanasia)					
1 2	27% 53%	5% 75%	13% 63%	43% 50%	3% 61%
3 4	2% 18%	2% 18%	4% 21%	2% 4%	1% 34%

5.3 Birds

5.3.1 Avian orders

The avian consultations amounted to 3267 for the 10 analysed years (Tab. 18). *Psittaciformes* was by far the most common order with 82%, followed by *Passeriformes* with 9%, *Galliformes* with 3%, *Anseriformes* and *Accipitriformes* with 2%, *Falconiformes* and other orders with less than 1%. From 2005 to 2014 the percentage of *Psittaciformes* decreased significantly (p=0.04) from initially 85% in 2005 to 78% in 2014. Meanwhile the share of *Galliformes* increased significantly from 3% to 6% (p<0.02). The other orders showed no significant changes.

5.3.2 Avian species

Table 27 *Non-exhaustive list of avian species presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

Order	Species
Psittaciformes	African Grey parrot *Psittacus erithacus*, Amazon parrot *Amazona ssp.*, cockatiel *Nymphicus hollandicus*, budgerigar *Melopsittacus undulatus*, lovebird *Agapornis ssp.*, macaw *Anodorhynchus hyacinthinus, Ara ssp.*, cacatoo *Cacatuidae*
Passeriformes	Canary *Serinus canarius domesticus,* zebra finch *Taeniopygia guttata*, hill mynah *Gracula religiosa,* Gouldian finch *Erythrura gouldinae,* goldfinch *Carduelis carduelis*
Galliformes	Chicken *Gallus gallus domesticus,* quails *Coturnix ssp.*, Guinea fowls *Numididae ssp.*, green peafowl *Pavo muticus*
Accipitriformes	Northern goshawk *Accipiter gentilis,* Harris's hawk *Parabuteo unicinctus*, sea eagles *Haliaeetus ssp.,* golden eagle *Aquila chrysaetos*
Falconiformes	Saker falcon *Falco cherrug,* peregrine falcon *Falco peregrinus,* gyrfalcon *Falco rusticolus*
Other Order	Waterfowl *Anseriformes,* pigeons *Columbiformes*, owls *Stringiformes*, toucans *Rhamphastidae,* hornbills *Tockus ssp.*

Among the different avian species that were presented for consultation, the budgerigar was the most common over the years (Tab. 28). There is a notable decrease in percentage for macaws from 4% in 2005 to 0% in 2014 and a significant one for the Amazon parrot from 15% to 10% in 2013 (p<0.03).

Table 28 *Percentages of total yearly consultations for the most common avian species presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 1994 to 2003 (Langenecker, 2006) and 2005 to 2014*

	1994 to 2003	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2005 to 2014
Budgerigar	37%	30%	28%	32%	25%	34%	36%	35%	30%	27%	33%	31%
African Grey	14%	12%	15%	18%	19%	12%	14%	13%	8%	8%	12%	13%
Amazon	14%	15%	14%	16%	15%	12%	12%	9%	13%	10%	13%	13%
Passeriformes	12%	9%	10%	3%	9%	10%	9%	9%	8%	8%	9%	8%
Cockatiel	7%	11%	10%	8%	6%	5%	4%	8%	10%	9%	10%	8%
Lovebird	4%	4%	3%	2%	4%	1%	2%	4%	4%	4%	2%	3%
Cockatoo	4%	3%	3%	2%	1%	6%	2%	2%	3%	8%	3%	3%
Macaw	6%	4%	2%	3%	3%	3%	4%	0%	7%	3%	0%	3%
Chicken		3%	1%	1%	5%	3%	2%	5%	1%	6%	6%	3%
Other	2%	9%	13%	15%	13%	13%	15%	14%	17%	18%	13%	14%

5.3.3 Budgerigars *Melopsittacus undulatus*

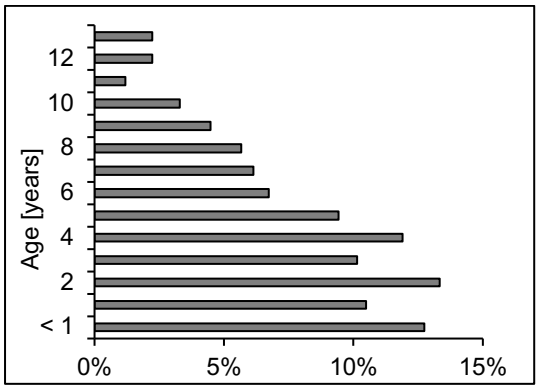

Figure 14 *Age distribution for budgerigars presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

The budgerigar was consistently the most commonly presented bird (Tab. 28). The main presenting complaints were for depression (17%), follow-up consultations (10%), abnormal excretions (8%) and respiratory problems (8%). Budgerigars presented as emergencies were diagnosed with gastrointestinal tract disorder (36%), trauma (15%) and hepatic disorder (12%). Animals that were referred to the clinic were diagnosed with gastrointestinal tract disorder (42%), trauma (19%), hepatic disorder (15%) or other diseases.

Table 29 *The top 10 presumptive diagnoses for budgerigar presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 1994 to 2003 (Langenecker 2006) and 2005 to 2014 (>1 diagnosis per consultation possible; for previous study only percentage of most prevalent disorders available)*

Presumptive disorder	Example of diagnosis	1994 to 2003[1]	2005 to 2014
Gastrointestinal tract disorder	Ingluvitis, enteritis, cloacal prolapse, endoparasites	14%	30%
Dermatologic disorder	Dermatitis, lipoma, pododermatitis, feather cyst, overgrown beak, ectoparasites	7%	21%
Hepatic disorder	Hepatopathy, neoplasia, cirrhosis, cysts	12%	11%
Trauma	Fractures, polytrauma, soft-tissue injury	11%	10%
Clinically healthy	Health check	-	9%
Unknown	No diagnosis due to very poor general condition	-	6%
Urinary tract disorder	Nephropathy, neoplasia	7%	6%
Respiratory tract disorder	Pneumonia, rhinitis, sinusitis	-	5%
Reproductive tract disorder	Salpingitis, dystocia, neoplasia	4%	4%
Body condition disorder	Obesity, cachexia	3%	3%

[1]Only neoplasia, trauma and crop diseases were analysed in detail in the previous study period. Percentages according to organ system are assumed to be estimates.

The percentage of animals diagnosed with gastrointestinal tract disorder per yearly consultations was between 20% (2012) and 42% (2007), but no significant trend could be detected in either direction (Fig. 14). Dermatologic disorders also showed some fluctuations. A significant downwards trend from 10% in 2005 to 4% in 2014 could be observed for hepatic disorders ($p<0.01$). From 12% in 2005 to 11% in 2014 there were no significant changes for trauma diagnoses.

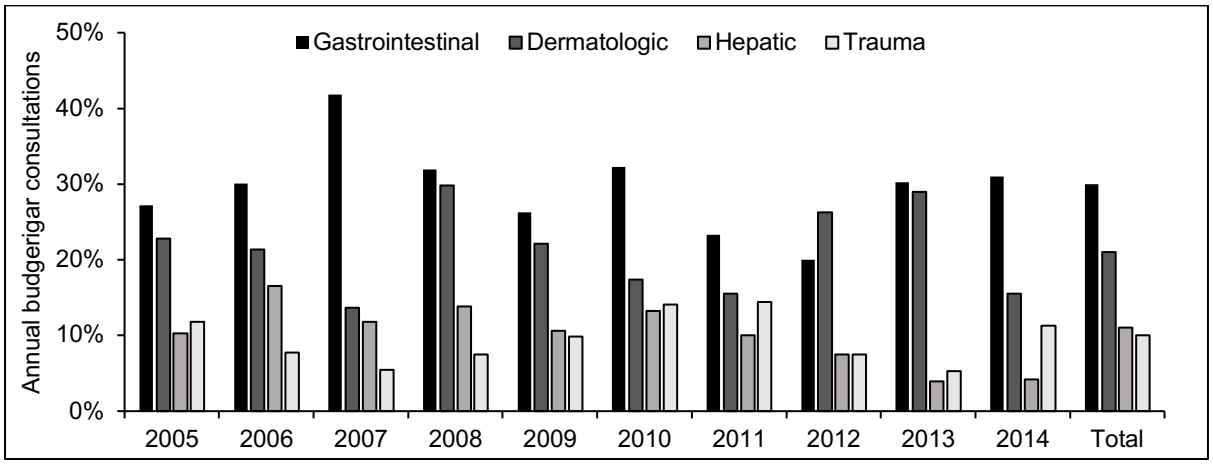

Figure 15 *Percentage of the top 4 presumptive diagnoses for budgerigar presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

Gender distribution was equal (Tab. 30); in 6% of budgerigar the gender was not reported. For trauma patients however, the males were more frequently affected than the females. Budgerigar between 1 and 10 years of age were presented most often, regardless of diagnosis. Hepatic disorders showed a deviation from the average age distribution with more of the older animals diagnosed than animals under 1 year of age. Animals with dermatologic disorders were often presented more than once, with 22% presenting for the fifth or more time. Backyard poultry were more often presented as emergencies than budgerigar (40% vs. 38%). In-patient admission had the highest rate for animals with gastrointestinal tract disorders and referral rate was highest for trauma patients.

Budgerigars with gastrointestinal disorders stayed longer at the clinic than the average budgerigar patients. Outcome was mostly positive in animals with dermatologic disorders, of which 90% were discharged after the consultations. However, budgerigars had the highest rate of all species for animals that died during their stay with 11%. This outcome was even more pronounced in animals diagnosed with (15%).

5.3.3.1 Consultations for budgerigars

Table 30 *Evaluation of all consultations and the top 4 presumptive diagnoses for budgerigar presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014 (% refer to % of all consultations or % of consultations with the specific diagnosis)*

			All consultations			**Gastrointestinal tract disorder**			**Dermatologic disorder**			**Hepatic disorder**			**Trauma**		
n			1003			297			212			107			97		
♂	♀		51%	43%		49%	45%		42%	51%		50%	45%		66%	26%	
Age [years]																	
< 1	**≥1<10**	**≥10**	12%	80%	8%	16%	79%	5%	13%	81%	6%	8%	84%	8%	19%	73%	8%
Consultation																	
First time	**≥5th time**		61%	15%		67%	10%		47%	22%		50%	18%		75%	11%	
Emergency			38%			46%			15%			42%			58%		
In-patient			36%			58%			19%			45%			41%		
Referral			3%			4%			2%			4%			5%		
Diagnosis																	
Diagnostic methods (max. 3 methods per patient)			radiography 23% crop smear 20% faecal smear 18%			crop smear 48% faecal smear 36% radiography 26%			bloodwork 8% cytology 5% PBFD[1] test 2%			radiography 47% bloodwork 30% ultrasound 6%			radiography 33%		
Presumptive diagnosis			-			enteritis 33% endoparasites 32% ingluvitis 16%			neoplasia 29% ectoparasites 17% overgrown beak 16%			hepatopathy 69% hepatolipidosis 3%			soft tissue injury 52% fracture 20% suspected head injury 9%		
Follow-up			-			9%			21%			21%			13%		
Treatment																	
Antibiotics			enrofloxacin 32% metronidazole 11%			enrofloxacin 50% metronidazole 33%			enrofloxacin 16% metronidazole 1%			enrofloxacin 45% metronidazole 8% doxycycline 5%			enrofloxacin 31% co-amoxiclav 4%		
Analgesia / anti-inflammatory			meloxicam 27% butorphanol 3%			meloxicam 25%			meloxicam 25%			meloxicam 22%			meloxicam 58% carprofen 4%		
Other			fluid supplementation 27% force feeding 11%			amphotericin B 31%			ivermectin 26% itraconazole 8%			itraconazole 21% liver support 50%			oxygen chamber 13% fluid supplementation 28%		
Intervention			anaesthesia 10%			laparotomy 1%			surgery 14%			claw trimming 5% beak trimming 3%			surgery 25%		
Length of stay [days]																	
1	**>1,≤4**	**≥5**	65%	22%	13%	43%	32%	25%	83%	11%	7%	55%	25%	20%	63%	25%	12%
Outcome (1 discharge without medication, 2 discharge with medication, 3 died during stay, 4 euthanasia)																	
1	**2**		36%	41%		16%	67%		57%	33%		35%	41%		18%	55%	
3	**4**		11%	12%		10%	7%		4%	5%		12%	12%		15%	12%	

[1] Psittacine beak and feather disease

5.3.4 Amazon parrots *Amazona ssp.*

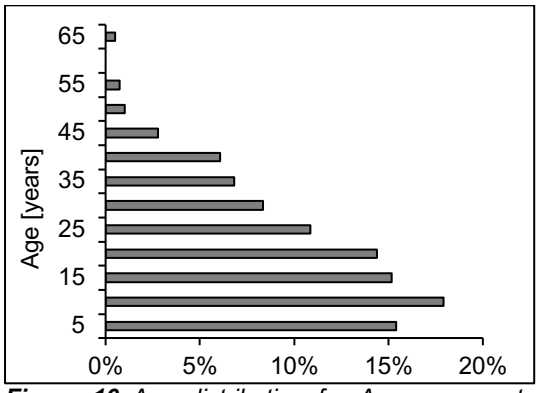

Figure 16 *Age distribution for Amazon parrots presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

More than 18 different (sub)species of Amazon parrots were presented during the study period. Blue-fronted Amazons (*A. aestival*, 38%) were the most common species, followed by yellow-crowned (*A. ochrocephala,* 11%) and yellow-shouldered (*A. barbadensis*, 4%). For 26% the exact species was not recorded.

Follow-up consultations were the reason for 24% of presentations for Amazon parrots. Animals with respiratory problems were 13% of all presentations, for depression 10% and for health checks 10%. The emergency consultations were mainly for respiratory tract disorders (39%), hepatic disorders (21%) and gastrointestinal tract disorders (18%). Referrals amounted to 7% and referred animals were diagnosed with respiratory tract disorder (34%), hepatic disorder (24%) and gastrointestinal disorder (21%). Respiratory tract disorders were the most common diagnosis in Amazon parrots (25%), followed by dermatologic disorders, hepatic disorders and trauma. Refer to table 31 for the 10 most common diagnoses in Amazon parrots.

Table 31 *The top 10 presumptive diagnoses for Amazon parrots presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 1994 to 2003 (Langenecker, 2006) and 2005 to 2014 (for previous study only percentage of most prevalent disorders were available)*

Presumptive disorder	Example of diagnosis	1994 to 2003	2005 to 2014
Respiratory tract disorder	Aerosacculitis, rhinitis, pneumonia, tracheitis	18%	25%
Dermatologic disorder	Overgrown beak, overgrown claws, pododermatitis	20%	23%
Hepatic disorder	Hepatopathy, hepatolipidosis, neoplasia	7%	16%
Trauma	Soft tissue injury, fracture, bite wound	7%	12%
Gastrointestinal tract disorder	Enteritis, ingluvitis, neoplasia, infectious disease	-	11%
Clinically healthy	Health check, gender determination	-	8%
Unknown	No diagnosis due to very poor general condition	-	4%
Intoxication	Lead, zinc, nicotine	-	3%
Ophthalmologic disorder	Conjunctivitis, cataract, corneal ulcer	5%	3%
Cardiovascular system disorder	Atherosclerosis, cardiomyopathy	-	3%

Between 15% (2006) and 40% (2010) of annual Amazon parrot patients were diagnosed with a respiratory tract disorder (Fig. 16). In the first half of the study period there was a visible increase for this diagnosis, but this trend did not continue after 2010. Dermatologic disorders were the second most common diagnosis and the data showed a nearly significant increase for this diagnosis ($p<0.09$). For hepatic disorders, there was a peak in 2010. Apart for this high, the percentage for this diagnosis was always between 10% and 19%. Amazon parrots diagnosed with trauma showed a significant decrease from the beginning of the observation period with 16% in 2005 to 4% in 2014 ($p<0.05$).

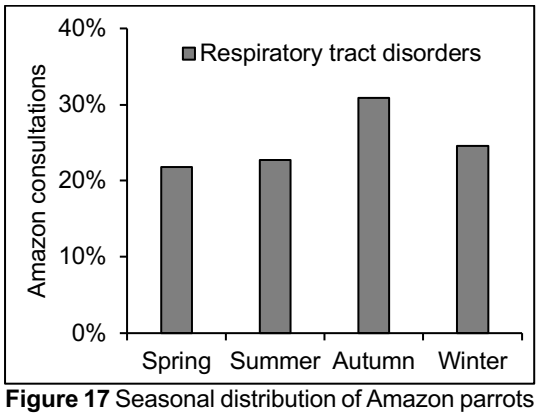

Figure 17 Seasonal distribution of Amazon parrots diagnosed with a presumptive respiratory tract disorder at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014

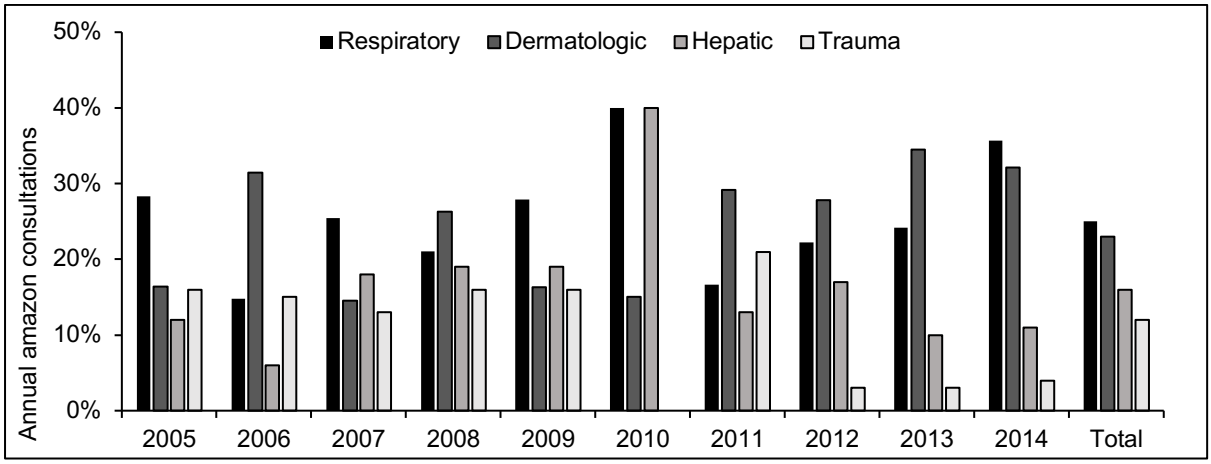

Figure 18 *Percentage of the top 4 presumptive diagnoses for Amazon parrots presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

Animals with dermatologic conditions were more likely to be males than the average Amazon parrot patient (Tab. 32). They also were mostly in the age category between 5 and 25 years, compared to trauma patients, which were mostly younger, and animals with a hepatic disorder, which were older than average. For the repeated consultations, the animals with dermatologic disorders were more likely to be presented more than 5 times. Emergencies and in-patient admissions were mainly for patients with respiratory tract disorders or trauma, and were also likely candidates for referrals just as animals with hepatic disorders. Amazon parrots had the highest rate of performed anaesthesia among the avian species regardless of the respective diagnosis.

Respiratory tract disorders were causing 32% of animals to stay for 5 days or more but positive outcome for these patients was still 80%. Animals with trauma, of which 94% could be discharged successfully, had the best outcome. Animals with hepatic disorders had the highest rate for animals with a negative outcome and also the highest percentage of animals that died during their stay.

5.3.4.1 Consultations for Amazon parrots

Table 32 *Evaluation of all consultations and the top 4 presumptive diagnoses for Amazon parrots presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014 (% refer to % of all consultations or % of consultations with the specific diagnosis)*

			All consultations			Respiratory tract disorder			Dermatologic disorder			Hepatic disorder			Trauma		
n			433			110			100			71			50		
♂	♀		44%	37%		40%	40%		61%	31%		34%	32%		46%	40%	
Age [years]																	
< 5	**≥5<25**	**≥25**	13%	61%	26%	6%	66%	28%	9%	80%	11%	1%	52%	47%	26%	48%	26%
Consultation																	
First time	**≥5th time**		53%	20%		65%	9%		16%	61%		51%	15%		52%	8%	
Emergency			30%			46%			4%			38%			42%		
In-patient			52%			72%			14%			56%			82%		
Referral			7%			9%			1%			10%			8%		
Diagnosis																	
Diagnostic methods (max. 3 methods per patient)			bloodwork 44% radiography 39%			radiography 65% bloodwork 65% galactomannan analysis 13% protein electrophoresis 7%			bloodwork 23%			bloodwork 77% radiography 55% ultrasound 6%			radiography 60%		
Presumptive diagnosis			-			aspergillosis 72% sinusitis 2%			overgrown beak 65% overgrown claws 24% pododermatitis 3%			hepatopathy 73% hepatolipidosis 3% hepatic neoplasia 2%			soft tissue injury 40% fracture 22% bite wound 4%		
Follow-up			-			18%			1%			20%			34%		
Treatment																	
Antibiotics			enrofloxacin 30% co-amoxiclav 4%			enrofloxacin 54% co-amoxiclav 4% doxycycline 4%			enrofloxacin 6% marbofloxacin 1%			enrofloxacin 34% doxycycline 6% co-amoxiclav 4%			enrofloxacin 30% co-amoxiclav 6%		
Analgesia / anti-inflammatory			meloxicam 28% butorphanol 9%			meloxicam 30%			meloxicam 26%			meloxicam 24%			meloxicam 60%		
Other			fluid supplementation 33%			itraconazole 71% enilconazole 13% terbinafine 4%			vitamin A 45%			liver support 54% vitamin A 23%			oxygen support 8%		
Intervention			anaesthesia 33%			endoscopy 7%			beak clipping 62% claw clipping 46%			endoscopy 1%			surgery 56%		
Length of stay [days]																	
1	**>1,≤4**	**≥5**	63%	19%	18%	40%	28%	32%	92%	3%	5%	55%	27%	18%	58%	26%	16%
Outcome (1 discharge without medication, 2 discharge with medication, 3 died during stay, 4 euthanasia)																	
1	**2**		42%	43%		12%	68%		77%	23%		35%	44%		30%	64%	
3	**4**		8%	7%		8%	12%		0%	0%		11%	10%		2%	4%	

5.3.5 Grey parrots *Psittacus erithacus*

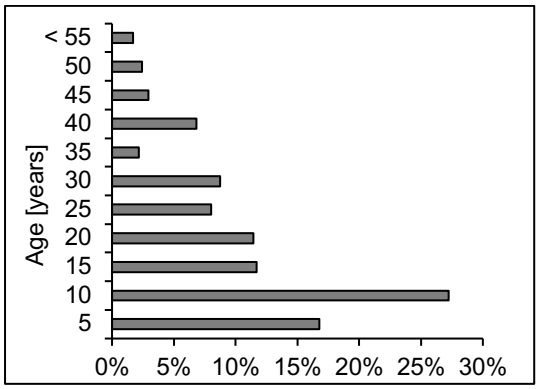

Figure 19 *Age distribution for Grey parrots presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

Grey parrots were mainly presented for respiratory problems (13%), health checks (11%), depression (8%) or follow-up (27%). The main reasons for emergencies were respiratory tract disorders (41%), hepatic disorders (15%) and trauma (14%). Referrals amounted to 7% of recorded consultations and were mainly for respiratory tract disorders (50%), gastrointestinal tract disorders (13%) or unspecific malnutrition disorders (10%). Presumptive respiratory tract disorder was the most common diagnosis for Grey parrots, just as for Amazon parrots (Tab. 31 and Tab. 33). In Grey parrots, respiratory tract disorders were more prevalent than in Amazon parrots (33% vs. 25%). Hepatic disorders and trauma were just as common in Grey parrots as in Amazon parrots, but dermatologic disorders occurred less often in Grey parrots.

Table 33 *The top 10 presumptive diagnoses for Grey parrots presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 1994 to 2003 (Langenecker, 2006) and 2005 to 2014 (>1 diagnosis per consultation possible; for previous study only percentage of most prevalent disorders available)*

Presumptive disorder	Example of diagnosis	1994 to 2003	2005 to 2014
Respiratory tract disorder	Aspergillosis, rhinitis, sinusitis	23%	33%
Hepatic disorder	Hepatopathy, cirrhosis, neoplasia	7%	14%
Dermatologic disorder	Overgrown beak, neoplasia, dermatitis, PBFD[1]	12%	13%
Trauma	Fracture, polytrauma, soft tissue injury	3%	12%
Gastrointestinal tract disorder	Enteritis, cloacitis, prolapse, proventricular dilatation	-	8%
Cardiovascular disorder	Atherosclerosis, cardiomyopathy	-	8%
Unspecific malnutrition	Vitamin A deficiency, hypocalcaemia	4%	8%
Clinically healthy	Health check, gender determination	-	7%
Urinary tract disorder	Nephropathy	-	6%
Ophthalmologic disorder	Cataract, neoplasia	-	5%

The percentage of Grey parrots with a respiratory tract disorder remained stable during the study period with the exception of 2012 (Fig. 20). Hepatic disorders showed a significant increase from 4% in 2005 to 42% in 2014 ($p<0.00$). Animals with dermatologic disorders were more often diagnosed between 2009 and 2011. During the rest of the study period the percentage for this diagnosis was always less than 10% of yearly consultations. Trauma was always an important diagnosis averaging as the fourth most common.

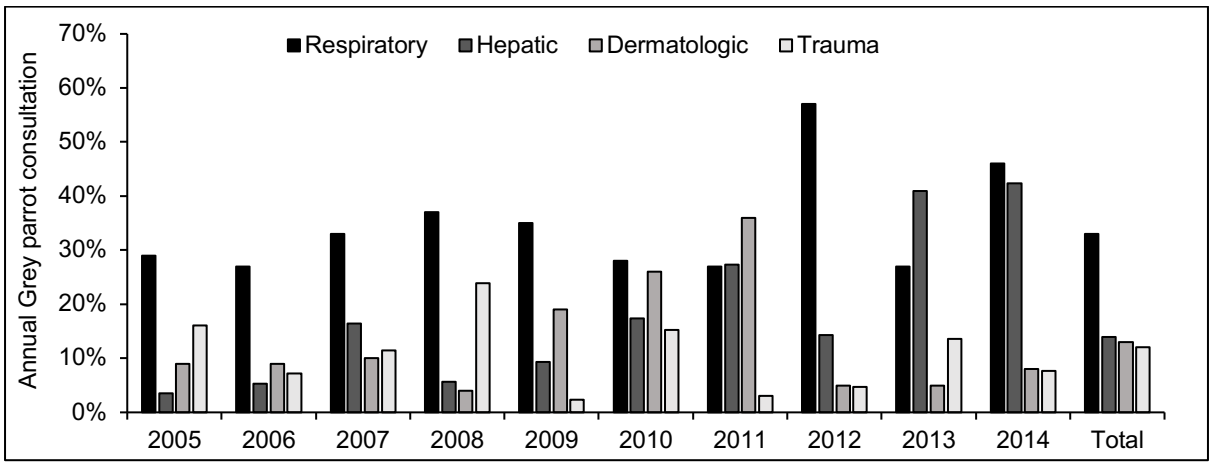

Figure 20 *Percentage of the top 4 presumptive diagnoses for Grey parrots presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

For 29% of Grey parrots the gender was undetermined, even more than in Amazon parrots (Tab. 32 and Tab. 34). Males were more prone to dermatologic disorders than females, but females were more often diagnosed with trauma. This diagnosis was as common in Amazon parrots more likely in young animals. In older birds, respiratory tract disorders were a more frequent diagnosis. Animals with dermatologic and hepatic disorders were presented more often than animals with respiratory tract disorders, but those had the highest rate for in-patient admission and also for referral.

Respiratory tract disorders were responsible for longer stays than the average Grey parrot patient. Outcome for all consultations in Grey parrots was similar to Amazon parrots with a rate of 85% of animals that could be discharged after the consultation. Animals with dermatologic disorders and trauma had mostly a positive outcome, whereas Grey parrots with hepatic disorders had the highest rate of euthanized animals and the outcome in general was less positive.

5.3.5.1 Consultations for Grey parrots

Table 34 *Evaluation of all consultations and the top 4 presumptive diagnoses for Grey parrots presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014 (% refer to % of all consultations or % of consultations with the specific diagnosis)*

			All consultations			Respiratory tract disorder			Hepatic disorder			Dermatologic disorder			Trauma		
n			436			144			63			55			52		
♂	♀		40%	31%		46%	22%		32%	37%		71%	22%		19%	52%	
Age [years]																	
< 5	**≥5<25**	**≥25**	13%	62%	25%	9%	72%	19%	5%	58%	37%	11%	65%	24%	25%	67%	8%
Consultation																	
First time	**≥5th time**		44%	33%		46%	17%		30%	41%		24%	40%		46%	37%	
Emergency			33%			41%			33%			11%			38%		
In-patient			35%			50%			37%			27%			29%		
Referral			7%			10%			2%			2%			6%		
Diagnosis																	
Diagnostic methods (max. 3 methods per patient)			bloodwork 49% radiography 35%			bloodwork 67% radiography 51% galactomannan 13% protein electrophoresis 4%			bloodwork 63% ultrasound 4%			bloodwork 42% PBFD[1] 14% cytology 8%			radiography 33% bloodwork 13%		
Presumptive diagnosis			-			aspergillosis 69% rhinitis 3%			hepatopathy 46% cirrhosis 2% hepatitis 2%			overgrown beak 18% neoplasia 9% dermatitis 9%			unspecific injury 21% fracture 17% polytrauma 6%		
Follow-up			-			23%			49%			35%			38%		
Treatment																	
Antibiotics			enrofloxacin 31% co-amoxiclav 7%			enrofloxacin 48% co-amoxiclav 4%			enrofloxacin 30% co-amoxiclav 10%			enrofloxacin 20% co-amoxiclav 15%			enrofloxacin 25%		
Analgesia / anti-inflammatory			meloxicam 23% butorphanol 5%			meloxicam 24%			meloxicam 22%			meloxicam 44%			meloxicam 31%		
Other			fluid supplementation 31%			terbinafine 42% ketoconazole 17% voriconazole 15%			liver support 49%			vitamin A 27%			local wound treatment 23%		
Intervention			inhalation therapy 13% anaesthesia 20%			endoscopy 3%			endoscopy 4%			wound treatment 18% beak correction 13% claw correction 4%			bandaging 35% fracture repositioning 6% amputation 4%		
Length of stay [days]																	
1	**>1,≤4**	**≥5**	65%	18%	17%	51%	21%	28%	66%	17%	17%	75%	7%	18%	75%	13%	12%
Outcome (1 discharge without medication, 2 discharge with medication, 3 died during stay, 4 euthanasia)																	
1	**2**		33%	54%		17%	68%		32%	50%		35%	62%		23%	67%	
3	**4**		7%	6%		9%	6%		8%	10%		0%	3%		6%	4%	

5.3.6 Backyard poultry *Galliformes and Anseriformes*

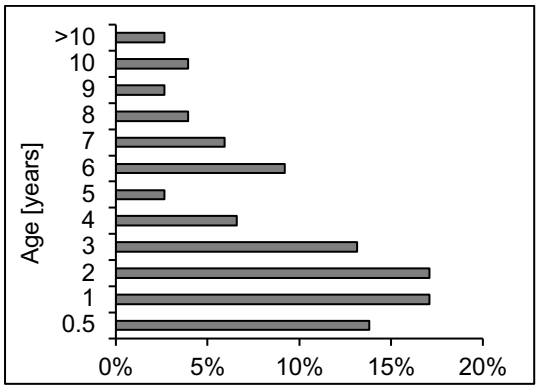

Figure 21 *Age distribution for backyard poultry presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

The order of *Galliformes* and *Anseriformes* were analysed together as backyard poultry. Together this group made up 5% of all avian consultations. The most common presenting complaints were depression (15%), trauma (15%), dermatologic changes (11%) and lameness (11%). Consultations for backyard poultry showed a peak in autumn (33%). Emergency consultations for this group was had a higher rate than for other birds with 40%. The main emergency diagnosis was trauma (31%). This group had also the highest euthanasia rate among the birds. Refer to table 35 for the information about the 10 most common diagnoses in poultry.

Table 35 *The top 10 presumptive diagnoses for backyard poultry presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014 (>1 diagnosis per consultation possible, *no comparable data available for 1994 to 2003)*

Presumptive disorder	Example of diagnosis	1992 to 2003	2005 to 2014
Gastrointestinal tract disorder	Enteritis, crop stasis, endoparasites	*	25%
Trauma	Bite wound, polytrauma, fracture	*	21%
Dermatologic disorder	Ectoparasites, pododermatitis	*	17%
Reproductive tract disorder	Dystocia, prolapse of cloaca	*	10%
Musculoskeletal disorder	Arthritis, arthrosis, osteomyelitis	*	9%
Respiratory tract disorder	Pneumonia, sinusitis, tracheitis	*	7%
Unknown	No diagnosis due to very poor general condition	*	5%
Neurologic disorder	Marek's disease, other infections	*	4%
Hepatic disorder	Hepatopathy	*	4%
Urinary tract disorder	Nephropathy	*	3%

In backyard poultry, gastrointestinal tract disorder was the most common disorder (Fig. 22). There was a significant increase in the percentage of gastrointestinal tract disorders from 13% in 2005 to 44% in 2014 ($p<0.03$). Trauma patients showed a negative trend from 35% in 2005 to 13% in 2014. For reproductive tract disorders, there was a positive trend during the study period.

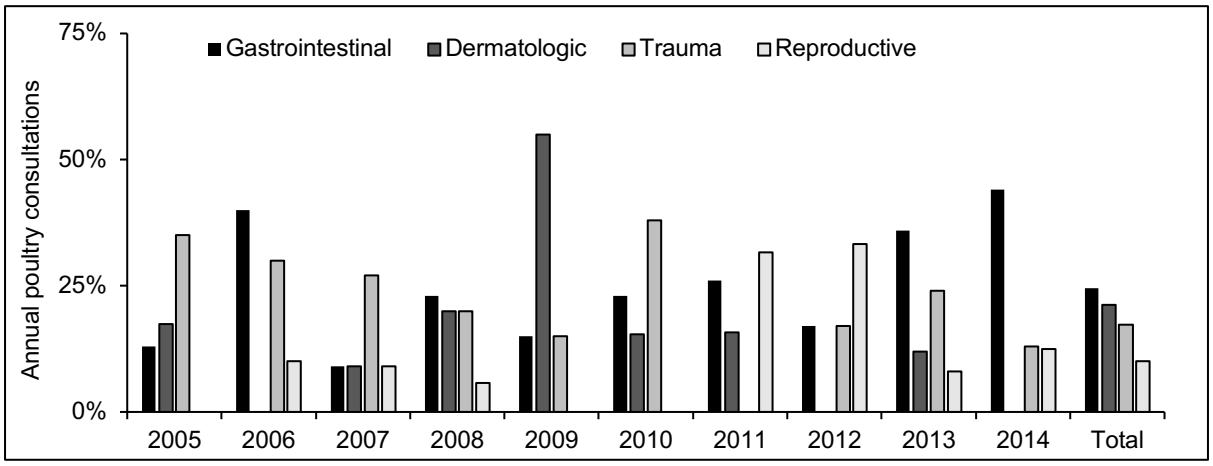

Figure 22 *Percentage of the top 4 presumptive diagnoses for backyard poultry presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

In backyard poultry females were presented more often than males regardless of diagnosis (Tab. 36). For dermatologic and reproductive tract disorders the female share was even higher than average. Regarding the age distribution of the affected patients, reproductive tract disorder was more often diagnosed in middle age poultry (81% for animals between 1 and 4 years of age) than any other diagnosis. Backyard poultry patients were often first-time patients unlike other bird species. Also, the rate of emergency consultations was higher, while in-patient admission and referral rate were close to the average for all bird species. Poultry with reproductive tract disorders had a high referral rate with 13%. Poultry with gastrointestinal tract disorders stayed often for more than 5 days compared to those with another diagnosis.

For all avian consultations 81% of animals could be discharged. In poultry, it was 72% and 18% of animals that were euthanized or died during their stay. Animals with reproductive tract disorder had a rather negative prognosis with a euthanasia rate of 38%.

5.3.6.1 Consultations for backyard poultry

Table 36 *Evaluation of all consultations and the top 4 presumptive diagnoses for backyard poultry presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014 (% refer to % of all consultations or % of consultations with the specific diagnosis)*

			All consultations			**Gastrointestinal disorder**			**Trauma**			**Dermatologic disorder**			**Reproductive tract disorder**		
n			178			44			38			31			16		
♂	♀		26%	55%		25%	52%		34%	55%		6%	71%		13%	69%	
Age [years]																	
< 1	**≥1, <4**	**≥4**	23%	40%	37%	22%	48%	30%	16%	53%	31%	16%	45%	39%	6%	81%	13%
Consultation																	
First time	**≥5th time**		83%	2%		84%	0%		92%	0%		77%	0%		75%	0%	
Emergency			40%			43%			58%			3%			38%		
In-patient			34%			45%			39%			10%			31%		
Referral			6%			9%			3%			6%			13%		
Diagnosis																	
Diagnostic methods (max. 3 methods per patient)			radiography 32% bloodwork 21%			radiography 36% bloodwork 27% ultrasound 9%			radiography 55% bloodwork 11%			scotch tape 16% cytology 16%			ultrasound 31% radiography 31%		
Presumptive diagnosis			-			cloacal prolapse 36% enteritis 16% ingluvitis 13% coelomitis 9%			soft tissue trauma 55% bite wound 13% fracture 11% polytrauma 8%			ectoparasites 55% pododermatitis 10% neoplasia 10% abscess 10%			salpingitis 44% dystocia 19% penis prolapse 13%		
Follow-up			-			9%			5%			13%			19%		
Treatment																	
Antibiotics			enrofloxacin 40% doxycycline 11%			enrofloxacin 48% doxycycline 7%			enrofloxacin 45% doxycycline 4%			enrofloxacin 29% co-amoxiclav 10%			enrofloxacin 56% co-amoxiclav 6%		
Analgesia / anti-inflammatory			meloxicam 39% butorphanol 5%			meloxicam 41%			meloxicam 55% carprofen 11%			meloxicam 29% carprofen 6%			meloxicam 69%		
Other			fluid supplementation 40%			toltrazuril 11%			fluid supplementation 45%			ivermectin 29%			GnRH analogue 25%		
Intervention			anaesthesia 18%			endoscopy 2%			wound treatment 39%			excision 13%			anaesthesia 13%		
Length of stay [days]																	
1	**>1,≤4**	**≥5**	68%	24%	8%	57%	27%	16%	63%	29%	8%	94%	3%	3%	68%	19%	13%
Outcome (1 discharge without medication, 2 discharge with medication, 3 died during stay, 4 euthanasia)																	
1	**2**		13%	59%		9%	68%		5%	74%		23%	74%		6%	56%	
3	**4**		8%	20%		5%	18%		8%	13%		0%	3%		0%	38%	

5.4 Reptiles

5.4.1 Reptilian orders

Reptiles were presented 3714 times (Tab.18). The yearly consultations showed a significant decrease over the analysed period ($p<0.01$). The animals were split equally between *Testudines* (47%) and *Squamata* (53%; 20% *Serpentes*, 33% *Sauria)*.

5.4.2 Reptilian species

Table 37 *Non-exhaustive list of reptilian species presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

Order or Suborder	Species
Testudines	Hermann's tortoise *Testudo hermanni*, spur-thighed tortoise *Testudo graeca*, Russian tortoise *Testudo horsfieldii*, marginated tortoise *Testudo marginata*, leopard tortoise *Stigmochelys pardalis,* radiated tortoise *Astrochelys radiata*
	Red-eared slider *Trachemys scripta elegans*, yellow-bellied slider *Trachemys scripta scripta*, painted turtle *Chrysemys picta*, northern map turtle *Graptemys geographica*, false map turtle *Graptemys pseudogeographica*, European pond turtle *Emys orbicularis*, box turtle *Terrapene carolina*, Chinese pond turtle *Mauremys reevesii*
Sauria	Bearded dragon *Pogona vitticeps*, green iguana *Iguana iguana*, Chinese water dragon *Physignathus cocincinus*, spiny-tailed lizard *Uromastyx ssp.*, frilled-necked lizard *Chlamydosaurus kingii*, leopard gecko *Eublepharis macularius*, collared lizard *Crotaphytus collaris*, curly-tailed lizard *Leiocephalus ssp.*, plumed basilisk *Basiliscus plumifrons*, panther chameleon *Furcifer pardalis*, veiled chameleon *Chamaeleo calyptratus*, blue-tongued skink *Tiliqua ssp.*, emerald tree monitor *Varanus prasinus*
Serpentes	Boa constrictor *Boa constrictor*, Dumeril's boa *Acrantophis dumerili*, anaconda *Eunectes notaeus*, Amazon tree boa *Corallus hortulanus*, emerald tree boa *Corallus caninus*, rainbow boa *Epicrates cenchria*, green tree python *Morelia viridis*, ball python *Python regius*, corn snake *Pantherophis guttatus*, sidewinder *Crotalus cerastes*, eastern indigo snake *Drymarchon couperi*, egg eating snake *Dasypeltis ssp.*, garter snake *Thamnophis ssp.*, kingsnake *Lampropeltis ssp.*, arboreal ratsnake *Gonyosoma oxycephalum*

Absolute numbers decreased significantly for tortoises ($p<0.02$), ball pythons ($p<0.03$), green iguana ($p<0.03$), other chelonians and *Sauria*, although bearded dragons showed a distinct increase from 1994-2003 to 2005. The percentage for all reptile consultations showed an almost ($p<0.09$) significant increase in bearded dragons and a decrease for the green iguana ($p<0.08$).

Table 38 *Percentages of total yearly consultations for reptiles presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 1994 to 2003 (Langenecker, 2006) and 2005 to 2014*

	1994 to 2003	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2005 to 2014
Testudo	32%	35%	43%	42%	39%	37%	36%	42%	34%	45%	35%	39%
Bearded dragon	9%	15%	14%	11%	12%	16%	20%	22%	22%	18%	17%	16%
Corn snake	4%	6%	6%	4%	5%	5%	8%	3%	2%	6%	5%	5%
Boa constrictor	7%	4%	4%	8%	11%	3%	8%	2%	2%	3%	5%	5%
Slider turtle	9%	5%	1%	4%	4%	7%	5%	6%	10%	4%	6%	5%
Ball python	5%	6%	4%	4%	4%	4%	4%	4%	3%	3%	4%	4%
Green iguana	8%	4%	5%	6%	5%	2%	2%	3%	3%	0%	4%	4%
Leopard gecko	3%	2%	5%	3%	2%	5%	3%	2%	4%	3%	5%	3%
Chameleon	-	2%	2%	1%	1%	2%	2%	2%	1%	0%	1%	1%
Other	23%	21%	15%	17%	18%	20%	13%	14%	18%	17%	17%	17%

5.4.3 Tortoises *Testudo ssp.*

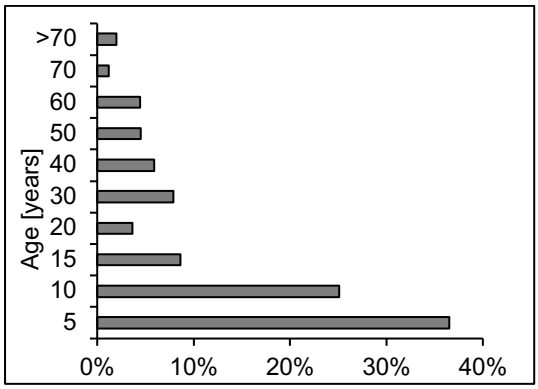

Figure 23 *Age distribution for tortoises presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

Four *Testudo* species accounted for 39% of all consultations; 46% were *Testudo* without information on specific species. *Testudo* identified as *Testudo hermanni* were 36%, 9% *Testudo graeca*, 5% *Testudo marginata* and 4% *Testudo horsfieldii*. Reason for presentation were follow-up consultation (25%), health check (17%) or endoparasites (12%). Emergency consultations were for trauma (27%), gastrointestinal tract disorder (26%) and respiratory tract disorder (16%). The most common presumptive disorder for *Testudo ssp*. were gastrointestinal tract disorders followed by trauma (Tab. 39).

Table 39 *The top 10 presumptive diagnoses for tortoises presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 1994 to 2003 (Langenecker, 2006) and 2005 to 2014 (>1 diagnosis per consultation possible; for previous study only percentage of most prevalent disorders were available)*

Presumptive disorder	Example of diagnosis	1994 to 2003	2005 to 2014
Gastrointestinal tract disorder	Endoparasites, coelomitis, post-hibernal anorexia	25%[1]	42%
Trauma	Bite-wound, fracture, amputation, polytrauma	14%	15%
Clinically healthy	Health check, gender determination	-	12%
Dermatologic disorder	Deformation of carapace or beak, carapace necrosis	-	9%
Musculoskeletal disorder	Metabolic bone disease, osteomyelitis, arthritis	10%	9%
Respiratory tract disorder	Pneumonia, URTD[2], herpesvirus infection	10%	7%
Reproductive tract disorder	Dystocia, penis prolapse, salpingitis	6%	5%
Cardiovascular disorder	Septicaemia, anaphylaxis, leukaemia	-	4%
Urinary tract disorder	Nephropathy, visceral gout	3%	4%
Ophthalmologic disorder	Conjunctivitis, vitamin deficiency, keratitis	3%	2%

[1]only for endoparasites in Langenecker (2006)
[2]upper respiratory tract disease

Even though gastrointestinal tract disorder was the most common diagnosis for *Testudo* ssp. over the whole study period, there was a significant decline of it form 49% in 2005 to 21% in 2014 ($p<0.01$; Fig. 24). At the same time, the percentage of animals with trauma increased significantly from 6% in 2005 to 21% in 2014 ($p<0.01$). The share of animals with dermatologic disorders showed an increase over the years ($p<0.06$). Meanwhile the diagnosis of musculoskeletal disorders showed not significant trend.

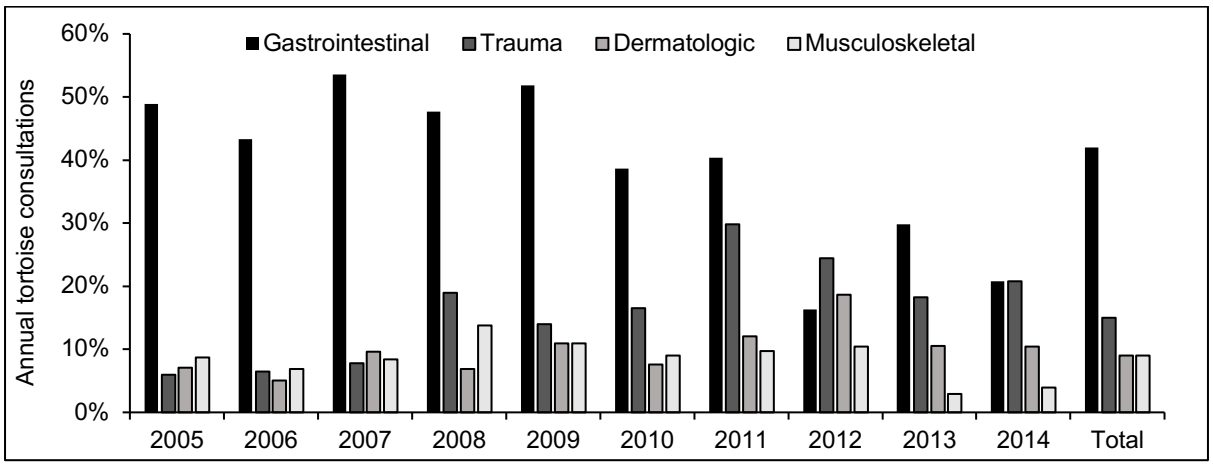

Figure 24 *Percentage of the top 4 presumptive diagnoses for tortoises presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

For 36% of *Testudo* ssp. patients the gender was undetermined (Tab. 40; 72% of animals with unrecorded gender were less than 10 years old). The animals with a dermatologic disorder showed a different gender distribution than average with 47% of diagnosed patients being male. Musculoskeletal disorders were mainly diagnosed in less than 10-year-old animals (82%) and dermatologic disorders in animals older than 10 years (88%). *Testudo spp.* with trauma were more often presented as emergencies than those with any other diagnoses. They also had the highest rate of in-patient admission. Also, animals with musculoskeletal disorders were admitted more often than average. Referrals were highest for dermatologic disorders.

Tortoises had the highest rate of animals that stayed for more than 5 days than any other analysed species. Outcome was best for animals with gastrointestinal disorders followed by those with dermatologic disorders. The worst outcome had animals with musculoskeletal disorders as they had a euthanasia rate of 16% and 2% died during their stay. Trauma patients had a higher than average rate of euthanasia with 10%.

5.4.3.1 Consultations for tortoises

Table 40 *Evaluation of all consultations and the top 4 presumptive diagnoses for tortoises presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014 (% refer to % of all consultations or % of consultations with the specific diagnosis)*

			All consultations			Gastrointestinal disorder			Trauma			Dermatologic disorder			Musculoskeletal disorder		
n			1441			610			211			131			127		
♂	♀		36%	28%		40%	23%		34%	27%		47%	16%		25%	26%	
Age [years]																	
<10	**10-40**	**≥40**	58%	29%	13%	62%	28%	10%	46%	45%	9%	12%	55%	33%	82%	17%	1%
Consultation																	
First time	**≥5th time**		50%	17%		40%	20%		54%	4%		53%	15%		67%	9%	
Emergency			19%			12%			36%			10%			29%		
In-patient			30%			27%			42%			16%			34%		
Referral			3%			4%			2%			8%			2%		
Diagnosis																	
Diagnostic methods (max. 3 methods per patient)			radiography 18% bloodwork 18% parasitology 11%			parasitological examination 33% bloodwork 19%			radiography 11% bloodwork 7%			bloodwork 19%			radiography 33% bloodwork 25%		
Diagnosis			-			endoparasites 56% post-hibernal anorexia 4% obstipation 4%			unspecific injury 32% bite wound 11% fracture 8%			overgrown beak 56% shell deformation 19% myasis 7%			metabolic bone disease 73% osteomyelitis 3% arthritis 2%		
Follow-up			-			29%			40%			11%			20%		
Treatment																	
Antibiotics			marbofloxacin 14% metronidazole 14% enrofloxacin 8%			marbofloxacin 12% enrofloxacin 8%			marbofloxacin 29% cephalosporin 11% enrofloxacin 10%			marbofloxacin 12% enrofloxacin 5%			marbofloxacin 16% enrofloxacin 10%		
Analgesia / anti-inflammatory			meloxicam 11% carprofen 2%			meloxicam 5%			meloxicam 37% carprofen 5%			meloxicam 17%			meloxicam 9%		
Other			fluid supplementation 28%			fenbendazole 54% metronidazole 31%			betadine locally 28%			fenbendazole 7%			calcium supplementation 48% vitamin D 13%		
Intervention			anaesthesia 9%			laparotomy 1% oesophageal tube 3%			wound treatment 59%			beak trim 55% wound treatment 18%					
Length of stay [days]																	
1	**>1,≤4**	**≥5**	70%	14%	16%	70%	9%	21%	58%	20%	22%	85%	8%	7%	66%	13%	21%
Outcome (1 discharged without medication, 2 discharged with medication, 3 died during stay, 4 euthanasia)																	
1	**2**		57%	34%		59%	37%		32%	58%		58%	34%		47%	35%	
3	**4**		2%	7%		1%	3%		0%	10%		0%	8%		2%	16%	

5.4.4 Slider turtles *Trachemys ssp.*

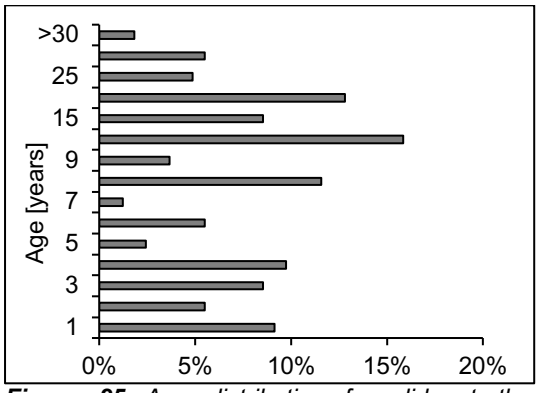

Figure 25 *Age distribution for slider turtles presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

70% of all terrapins (*Emydidae*) were pond sliders (*Trachemys ssp.*). Red-eared sliders were the most common species with 44% (Fig. 25), followed by 35% yellow-bellied sliders and for 21% the exact species was not given.

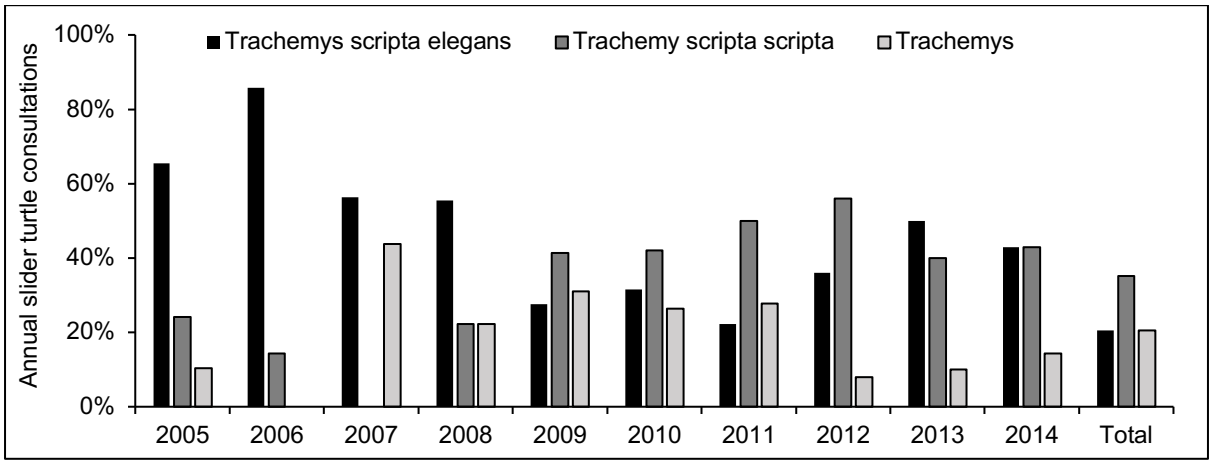

Figure 26 *Species distribution for slider turtles presented the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

Follow-up was the reason for 25% of all slider turtle consultations. Another 9% were presented for a health check, 11% for anorexia, 9% for eye problems and 8% after a trauma. Emergency consultations were mainly for ophthalmologic disorders (25%), respiratory tract disorder (21%) and reproductive disorder (17%). Referred animals were mainly diagnosed with reproductive tract disorder (43%), gastrointestinal tract disorder (29%) and cardiovascular disorder (14%).

Table 41 *The top 10 presumptive diagnoses for slider turtles presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 1994 to 2003 (Langenecker, 2006) and 2005 to 2014 (>1 diagnosis per consultation possible; for previous study only percentage of most prevalent disorders available)*

Presumptive disorder	Example of diagnosis	1994 to 2003	2005 to 2014
Ophthalmologic disorder	Blepharitis (hypovitaminosis A), conjunctivitis, keratitis	28%	20%
Dermatologic disorder	Shell rot, SCUD[1], overgrown beak	-	15%
Trauma	Shell fracture, bite wound, amputation	15%	13%
Reproductive tract disorder	Dystocia, penis prolapse	5%	12%
Clinically healthy	Health check	-	11%
Gastrointestinal tract disorder	Endoparasites, prolapse cloaca, coelomitis	4%	10%
Neurologic disorder	Otitis, ear abscess	4%	8%
Respiratory tract disorder	Pneumonia, rhinitis	10%	7%
Cardiovascular disorder	Septicaemia	-	5%
Urinary tract disorder	Nephropathy	-	3%

[1]Septicemic Cutaneous Disease

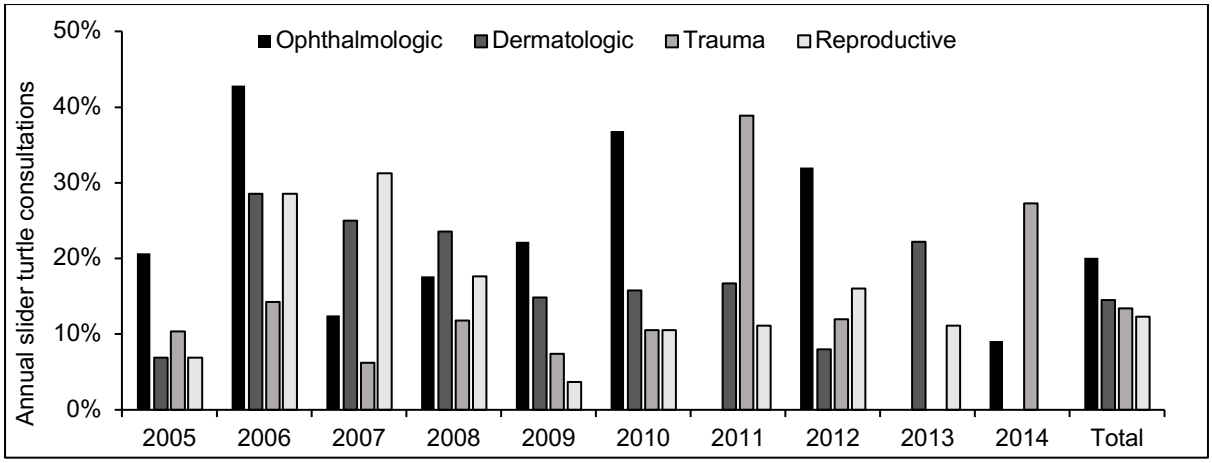

Figure 27 *Percentage of the top 4 presumptive diagnoses for Slider turtles presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

The gender distribution among the Slider turtle patients leaned heavily towards the female animals (Tab. 42), especially in reproductive tract disorders. Trauma patients were more often male than average. Reproductive tract disorders were likely to be older than the average Slider turtle patient with 68% of animals older than 15 years. They also had the highest rate of return patients, emergency consultations, inpatient admission and referrals.

Slider turtles were more likely to stay for more than one day than tortoises. Slider turtles with reproductive tract disorders stayed more than one day after 59% of consultations. Positive outcome for Slider turtles was 2% higher than for tortoises but more Slider turtles were discharged with medication than tortoises.

5.4.4.1 Consultations for slider turtles

Table 42 *Evaluation of all consultations and the top 4 presumptive diagnoses for Slider turtles presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014 (% refer to % of all consultations or % of consultations with the specific diagnosis)*

			All consultations			**Ophthalmologic disorder**			**Dermatologic disorder**			**Trauma**			**Reproductive tract disorder**		
n			178			36			26			24			22		
♂	♀		20%	42%		19%	17%		8%	50%		42%	29%		18%	82%	
Age [years]																	
< 5	**≥5<15**	**≥15**	33%	42%	25%	36%	56%	8%	15%	73%	8%	17%	28%	56%	18%	14%	68%
Consultation																	
First time	**≥5th time**		63%	7%		69%	0%		58%	15%		63%	8%		59%	9%	
Emergency			30%			36%			15%			29%			41%		
In-patient			40%			39%			27%			50%			59%		
Referral			4%			3%			4%			0%			14%		
Diagnosis																	
Diagnostic methods (max. 3 methods per patient)			radiography 21% bloodwork 15%			ophthalmologic exam 6% radiography 19%			bloodwork 27% bacterial culture 12%			radiography 4% computed tomography 4%			radiography 50% bloodwork 18%		
Presumptive diagnosis			-			blepharitis (hypovitaminosis A) 75% keratitis 3%			shell necrosis 46% overgrown beak 23% dermatitis 8%			unspecific injury 46% shell fracture 13%			dystocia 50% penis prolapse 18%		
Follow-up			-			22%			19%			33%			23%		
Treatment																	
Antibiotics			marbofloxacin 20% enrofloxacin 11% cephalosporin 8%			marbofloxacin 19% enrofloxacin 8%			marbofloxacin 27% cephalosporin 12%			enrofloxacin 25% marbofloxacin 13%			doxycycline 32% cephalosporin 27%		
Analgesia / anti-inflammatory			meloxicam 20% carprofen 2%			meloxicam 11%			meloxicam 8%			meloxicam 33% carprofen 8%			meloxicam 32%		
Other			fluid supplementation 34%			vitamin A 61%			vitamin A 42%			fluid supplementation 29%			oxytocin 27%		
Intervention			anaesthesia 14%			-			betadine topically 35%			wound treatment 33%			laparotomy 9%		
Length of stay [days]																	
1	**>1,≤4**	**≥5**	62%	23%	14%	69%	25%	6%	81%	12%	8%	50%	25%	25%	41%	41%	18%
Outcome (1 discharge without medication, 2 discharge with medication, 3 died during stay, 4 euthanasia)																	
1	**2**		48%	45%		50%	50%		38%	54%		42%	58%		41%	55%	
3	**4**		3%	4%		0%	0%		8%	0%		0%	0%		5%	0%	

5.4.5 Bearded dragons *Pogona vitticeps*

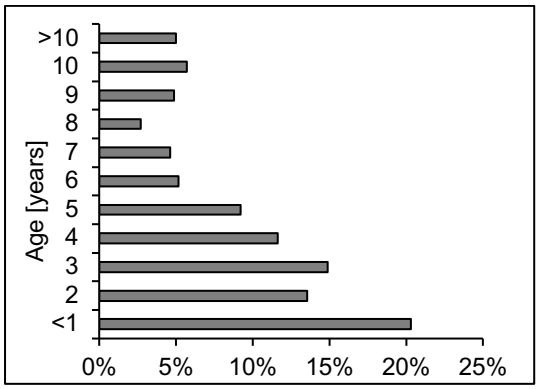

Figure 28 *Age distribution for bearded dragons presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

The main presenting complaints were clinical signs related to the gastrointestinal tract (27%; suspicion of endoparasites, retching, enlarged abdomen), depression (15%), anorexia (13%) or a follow-up consultation (17%). Emergency patients were diagnosed mainly with gastrointestinal tract disorder (45%), reproductive tract disorder (17%) and musculoskeletal disorder (17%). Only 2% of consultations were referrals and these mostly for gastrointestinal tract or dermatologic disorder 29% for both. Gastrointestinal tract disorder was by far the most common diagnosis in bearded dragons with 44%. Refer to table 43 for 10 most prevalent diagnoses in this species. For further analysis, dermatologic disorders were considered the 4th most common diagnosis.

Table 43 *The top 10 presumptive diagnoses for bearded dragons presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 1994 to 2003 (Langenecker, 2006) and 2005 to 2014 (>1 diagnosis per consultation possible; for previous study only percentage of most prevalent disorders available)*

Presumptive disorder	Example of diagnosis	1994 to 2003	2005 to 2014
Gastrointestinal tract disorder	Endoparasites, enteritis, cloacal prolapse, obstipation	28%	44%
Musculoskeletal disorder	Metabolic Bone Disease, osteomyelitis, arthritis	19%	14%
Trauma	Fractures, polytrauma, unspecific injury	18%	11%
Clinically healthy	Health check, castration, gender determination	-	9%
Dermatologic disorder	Dyecdysis, mycosis	6%	8%
Reproductive tract disorder	Dystocia, salpingitis, hemipenis prolapse	8%	8%
Respiratory tract disorder	Pneumonia	4%	7%
Hepatic disorder	Hepatolipidosis, hepatopathy	6%	4%
Unknown	No diagnosis due to very poor general condition	-	4%
Urinary tract disorder	Nephropathy	-	3%

Gastrointestinal tract disorder was the most common disorder in bearded dragons for every year of the analysed period (Fig. 29). The three other common diagnoses followed no upwards or downwards trend over the 10-years. Excluding the first year from the analysis, there was a downwards trend for dermatologic and musculoskeletal disorders, albeit not a significant one ($p<0.06$; $p<0.07$).

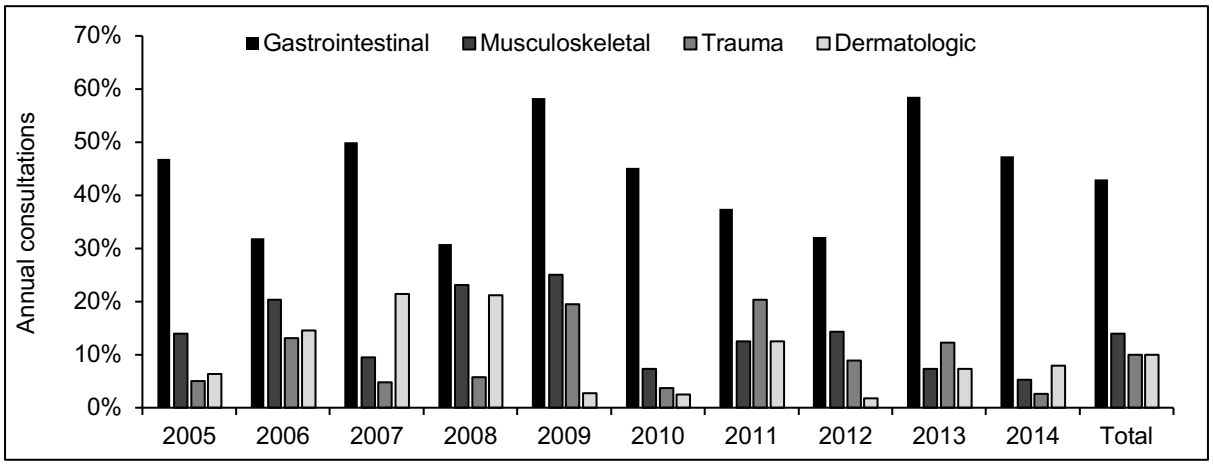

Figure 29 *Percentage of the top 4 presumptive diagnoses for bearded dragons presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

Among the most common reptiles, the rate of animals with an undetermined gender was lowest in bearded dragons (19%; Tab. 44). More female than male bearded dragons were presented. For musculoskeletal disorders and trauma patients the ratio was inversed. Musculoskeletal disorders were also more likely to affect younger bearded dragons than any other diagnosis. Animals with dermatologic disorders had a much higher rate of returning for consultation than for any other diagnosis. For emergencies and inpatient admission, musculoskeletal disorders were again in top position, followed by trauma patients and animals with gastrointestinal disorders. Referral rate for bearded dragons was low overall with 2%; 7% of animals with dermatologic disorders were referred.

Length of stay for bearded dragons was mostly less than 5 days (93%) and there was no difference for this criterion among the top 4 diagnosis groups. Outcome for animals with musculoskeletal disorders or trauma was less positive than average and more than 15% of these animals had to be euthanized.

5.4.5.1 Consultations for bearded dragons

Table 44 *Evaluation of all consultations and the top 4 presumptive diagnoses for bearded dragons presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014 (% refer to % of all consultations or % of consultations with the specific diagnosis)*

			All consultations			**Gastrointestinal tract disorder**			**Musculoskeletal disorder**			**Trauma**			**Dermatologic disorder**		
n			595			259			86			59			54		
♂	♀		36%	45%		35%	46%		48%	38%		42%	39%		43%	40%	
Age [years]																	
< 1	**≥1<10**	**≥10**	13%	80%	7%	12%	81%	7%	22%	65%	13%	14%	78%	8%	9%	85%	6%
Consultation																	
First time	**≥5th time**		65%	4%		66%	0%		62%	16%		61%	3%		65%	35%	
Emergency			29%			31%			34%			34%			11%		
In-patient			32%			32%			47%			32%			33%		
Referral			2%			2%			0%			2%			7%		
Diagnosis																	
Diagnostic methods (max. 3 methods per patient)			radiography 34% bloodwork 23%			parasitology 49% radiography 34%			radiography 63% bloodwork 34%			radiography 47%			cytology 26% bloodwork 11%		
Presumptive diagnosis			-			endoparasites 66% obstipation 7% cloacal prolapse 7%			MBD[1] 51% osteomyelitis 16%			soft tissue injury 32% fracture 31% bite injury 7%			necrosis tail or toe 30% dysecdysis 13% CANV[2] 13%		
Follow-up			-			11%			21%			25%			22%		
Treatment																	
Antibiotics			marbofloxacin 14% enrofloxacin 14%			enrofloxacin 10% metronidazole 11%			enrofloxacin 23% marbofloxacin 23%			marbofloxacin 20% enrofloxacin 19%			marbofloxacin 20% enrofloxacin 17%		
Analgesia / anti-inflammatory			meloxicam 22%			meloxicam 19%			meloxicam 29%			meloxicam 49% carprofen 7%			meloxicam 19%		
Other			fluid supplementation 35%			toltrazuril 41% fenbendazole 38%			calcium 36% vitamin D 3%			calcium 14%			itraconazole 11% enilconazole 7%		
Intervention			anaesthesia 115			laparotomy 2%			wound treatment 21%			bandaging 14%			amputation 9%		
Length of stay[days]																	
1	**>1,≤4**	**≥5**	68%	25%	7%	69%	23%	8%	53%	41%	6%	68%	24%	8%	70%	22%	8%
Outcome 1 discharge without medication, 2 discharge with medication, 3 died during stay, 4 euthanasia																	
1	**2**		36%	47%		36%	53%		19%	65%		27%	54%		24%	67%	
3	**4**		4%	13%		3%	8%		3%	16%		2%	17%		0%	9%	

[1]Metabolic bone disease

[2]*Chrysosporium anamorph of Nannizziopsis vriesii*

5.4.6 Boid snakes *Boidae ssp.*

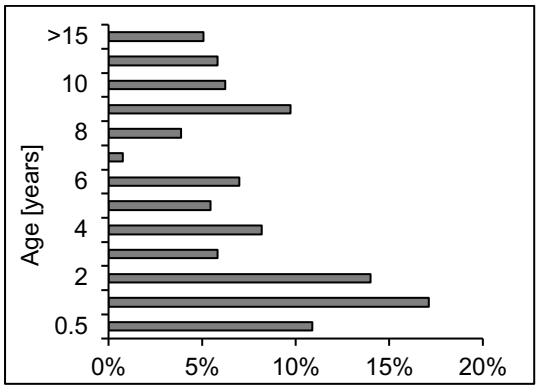

Figure 30 *Age distribution for boids presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

The species of *Boidae* included *Boa constrictor (*74%), Dumeril's boa (12%), rainbow boas (8%), tree boas (4%; 82% emerald tree boa, 18% Amazon tree boa) and other species. Around 23% were presented for suspicion of BIBD, 14% for a health check or sexing and 13% for respiratory signs. Follow-ups accounted for 11% of consultations. Systemic infection was by far the most common diagnosis in boid snakes. Refer to table 45 for the 10 most common diagnoses in this species. The third most common diagnosis was for healthy animals that were presented for a general health check, gender determination or a BIBD check.

Table 45 *The top 10 presumptive diagnoses for boids presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 1994 to 2003 (Langenecker, 2006) and 2005 to 2014 (for previous study only percentage of most prevalent disorders were available)*

Presumptive disorder	Example of diagnosis	1994 to 2003	2005 to 2014
Systemic Infection	BIBD[1], septicaemia	13%	40%
Gastrointestinal tract disorder	UATD[2], tympany, obstipation,	21%	20%
Healthy	Health check, gender determination, BIBD check	-	16%
Dermatologic disorder	Ectoparasites, dysecdysis, retained spectacle	21%	15%
Respiratory tract disorder	Pneumonia	13%	13%
Trauma	Bite injury, burn wound, soft tissue injury	-	6%
Reproductive tract disorder	Dystocia	-	2%
Intoxication	Various substances	-	2%
Unknown	No diagnosis due to very poor general condition	-	2%
Urinary tract disorder	Nephropathy	-	1%

[1] Boid Inclusion Body Disease
[2] Upper Alimentary Tract Disease

Systemic infection was the diagnosis for 40% of boids (Fig. 32), of which 62% were presented between 2008 and 2010. The top 4 diagnoses in boid snakes showed no positive or negative trend over the analysed 10-year period.

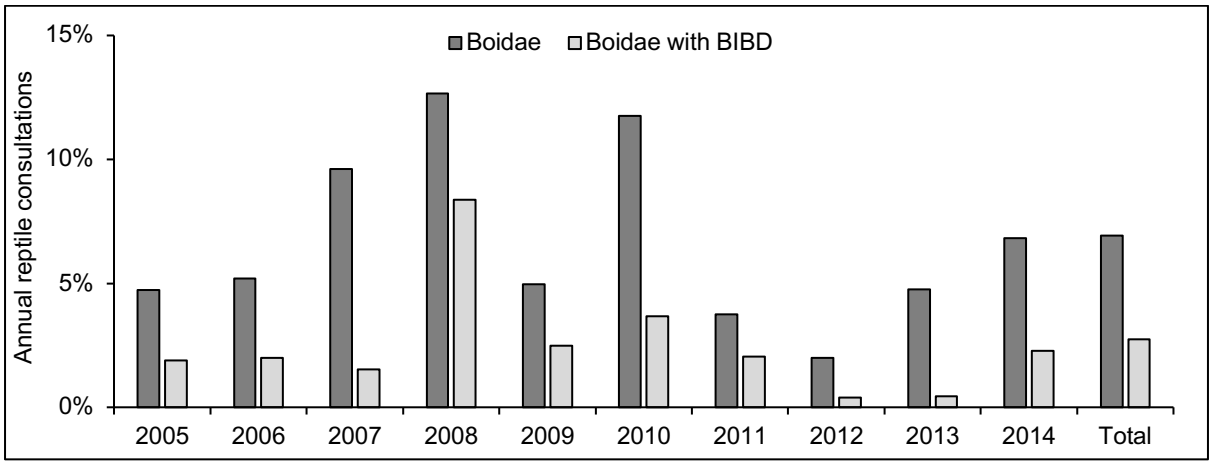

Figure 31 *Percentage of the annual reptile consultations for boids and boids with BIBD presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

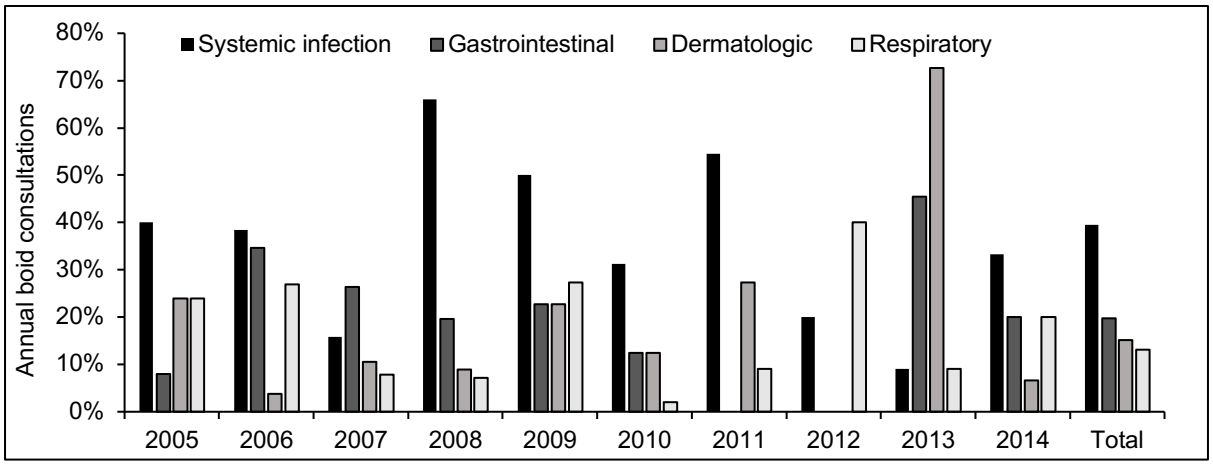

Figure 32 *Percentage of the top 4 presumptive diagnoses for boids presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

Boids had a high rate of animals for which the gender was undetermined (32%; Tab. 46). Only 6% of boid patients were older than 15 years. They were very rarely presented more than 5 times (1%) and had the lowest rate of emergency consultation of all analysed reptile species (12%). Inpatient admission was higher than average in animals with respiratory tract infection and these also had the highest rate for animals staying more than 5 days after a consultation. Referral rate for boids was 1%. The outcome for these species was almost the same as for other reptiles, but animals with systemic infections had the highest euthanasia rate with 34% as did animals with respiratory tract infections (24%)

5.4.6.1 Consultations for boid snakes

Table 46 *Evaluation of all consultations and the top 4 presumptive diagnoses for boids presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014 (% refer to % of all consultations or % of consultations with the specific diagnosis)*

			All consultations			Systemic Infection			Gastrointestinal disorder			Dermatologic disorder			Respiratory tract disorder		
n			257			102			51			39			34		
♂	♀		26%	42%		21%	36%		33%	53%		18%	41%		18%	65%	
Age [years]																	
< 3	**≥3<15**	**≥15**	42%	51%	6%	37%	56%	7%	35%	59%	6%	28%	69%	3%	21%	68%	12%
Consultation																	
First time	**≥5th time**		77%	1%		75%	0%		67%	2%		79%	0%		71%	0%	
Emergency			12%			12%			16%			21%			26%		
In-patient			26%			21%			43%			41%			65%		
Referral			1%			2%			2%			3%			0%		
Diagnosis																	
Diagnostic methods (max. 3 methods per patient)			bloodwork 46% radiography 14%			bloodwork 72% bacterial culture 4%			bloodwork 35% radiography 35%			bloodwork 49% surface cytology 21%			bloodwork 50% bacterial culture 47%		
Presumptive diagnosis			-			BIBD 93% septicaemia 3%			UATD 41% endoparasites 18% obstipation 10%			ectoparasites 36% dysecdysis 28% retained spectacle 13%			pneumonia 94%		
Follow-up			-			4%			20%			8%			6%		
Treatment																	
Antibiotics			marbofloxacin 16% enrofloxacin 8%			enrofloxacin 11% marbofloxacin 11%			marbofloxacin 29% cephalosporin 14%			marbofloxacin 28% cephalosporin 10%			marbofloxacin 47% enrofloxacin 24%		
Analgesia / anti-inflammatory			meloxicam 12% carprofen 2%			meloxicam 7%			meloxicam 25%			meloxicam 18%			meloxicam 12%		
Other			fluid supplementation 19%			-			fluid supplementation 31%			fipronil 15%			-		
Intervention			anaesthesia 6%			-			wound treatment 28%			bathing 33%			inhalation therapy 44%		
Length of stay [days]																	
1	**>1,≤4**	**≥5**	74%	14%	12%	80%	10%	10%	56%	22%	22%	56%	26%	18%	38%	29%	33%
Outcome 1 discharge without medication, 2 discharge with medication, 3 died during stay, 4 euthanasia																	
1	**2**		47%	33%		37%	25%		39%	47%		36%	54%		12%	62%	
3	**4**		2%	18%		3%	34%		4%	10%		5%	5%		3%	24%	

6 DISCUSSION

6.1 Material and methods

Subjectively, record taking has improved over the analysed time period facilitating data extraction. In the handwritten records, missing data was a common problem, affecting for example correct identification of the patient with species, gender and age.

The definition of diagnosis proved particularly difficult due to insufficient information on localisation of a lesion or the interchangeable use of causative agent and diagnosis. Sorting the diagnoses by organ system proved valuable to achieve a consistency for analysis throughout the different species. When comparing the results from Langenecker (2006) with the results from this study, one has to bear in mind that even though the methodology is similar, it was impossible to reproduce it completely. For some disorders, a certain bias is suspected due to lack of relevance of a certain diagnosis. For example, obesity is very common problem in privately owned rats but it was only recorded and therefore analysed in 3% of patients. Similar bias is expected for feather loss in psittacine species and other disorders with little life-threatening potential.

6.2 Results

From 1994 to 2003, n=11833 consultations were recorded at the Clinic for Zoo Animals Exotic Pets and Wildlife. 10 years later this number increased by 28% to n=15189. This was mostly due to increase in annual consultations until 2009. That year showed an absolute peak at n=1897 consultations but afterwards yearly consultations decreased again to numbers similar to the year 2000.

Already in the previous study, an upwards trend for consultations was noted, and it was hypothesized that this was due to an increase in popularity in exotic pets and a preference of owners for specialised clinics (Langenecker 2006). The recent study confirms this upward trend, together with sources from other European countries (Kraft 2005; Vermeulen et al. 2008) and statistics on pet ownership from Switzerland (Hausinfo 2017) and the United States (AVMA 2012). It seems that the popularity of exotic pets is still on the rise.

The decrease seen after 2009 is most certainly due to a change in internal policy on patient admission. The aim of the clinic is not a high throughput rate, but more refined diagnostic and treatments as well as in-depth practical education of veterinary students. Another reason for the decrease in annual consultation might be the increasing knowledge of private practitioners about exotic pets, which could lead to a decrease of animal number at specialised clinics or maybe also an increase in referrals (discussed in 7.2.1.3). In Switzerland, exotic pet medicine was introduced to the core veterinary curriculum and became part of the examination program in 2001 and there are strong calls for better education in exotic pet medicine worldwide (Flammer 2006; Jacobson et al. 2006; Redrobe 2008). Redrobe (2008) even goes further and calls rabbit medicine “mainstream” in clinical veterinarian practice.

6.3 Class distribution

Mammals were the most prominent class in terms of yearly consultations from 1994 to 2014 (Fig. 33). The percentage of yearly mammal consultations increased significantly ($p<0.02$) from 46% in 1994 to 65% in 2014. This meant a significant decrease in the percentage of reptile consultations ($p<0.00$). The share of avian consultations fluctuated between 17% and 25% with an exceptional peak of 27% in 2001.

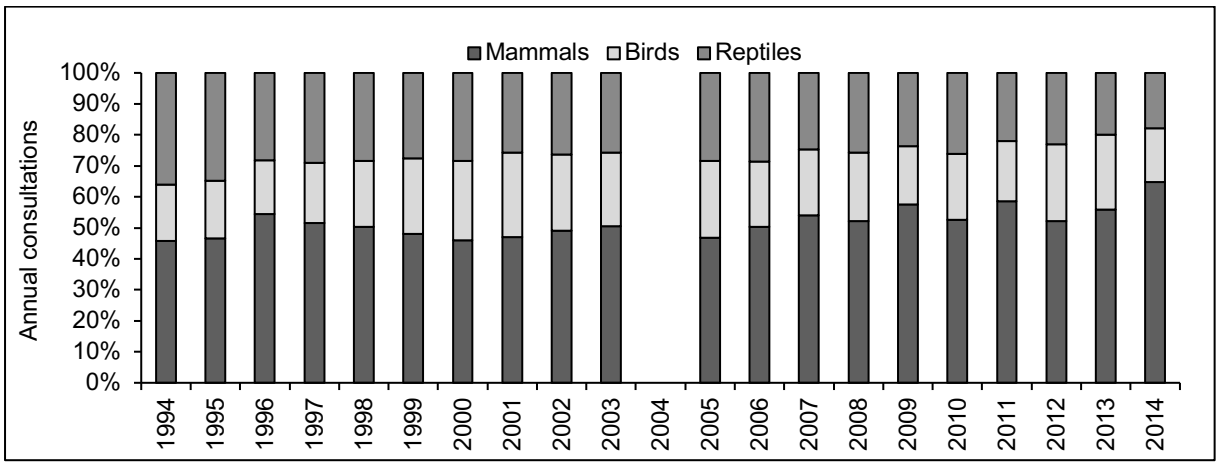

Figure 33 *Class distribution for patients presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 1994 to 2003 (Langenecker, 2006) and 2005 to 2014*

As seen in the previous literature review, there is no comparable data to the order distribution in exotic pet practices. An average of 52% for mammals over the last 20 years is lower than other studies with similar methodology, where mammals held a share of over 80% (Hill and Williams 2006; Kirschbaum 1994; Rheker 2001). The decline of reptile consultations and the stagnation of the percentage for birds is in contradiction to data from the Netherlands from 2005 (Vermeulen et al. 2008) where the authors saw a doubling in the number of birds and reptiles since 1994 and predicted a continued trend. But again, the shares by class might be artificially influenced by the specialisation of a clinic towards a certain class as well as factors on species level, which will be discussed further down.

6.4 Consultations

6.4.1 Emergency

The percentage of animals that were presented as emergencies increased in comparison with the last study period (Fig. 34). This upward trend also continued from 2005 to 2014 (Fig. 3) and is following the general trend of increased emergency consultations at the Small Animal Hospital of the University of Zurich, Switzerland (Siegrist, N, personal communication 2018)

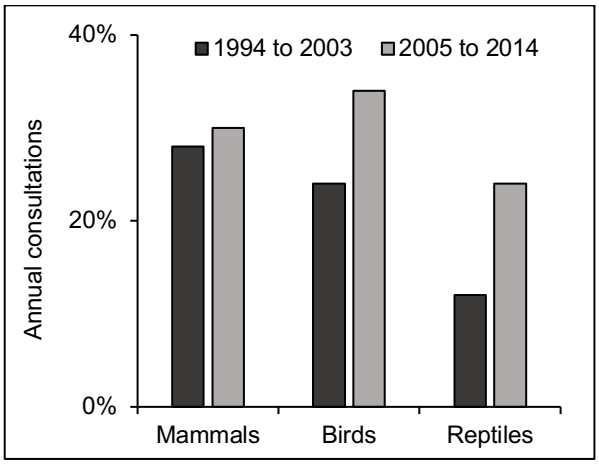

Figure 34 *Percentage of emergency consultations for animals presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 1994 to 2003 (Langenecker, 2006) and 2005 to 2014*

6.4.2 Repeated consultations

The most significant increase for repeat consultations was in reptiles ($p<0.01$), which could be associated with increased owner awareness for the animal's welfare. The differences between the classes could be explained by the marked difference of the life spans between less than 2 years for certain mammals and over 80 years for some reptiles.

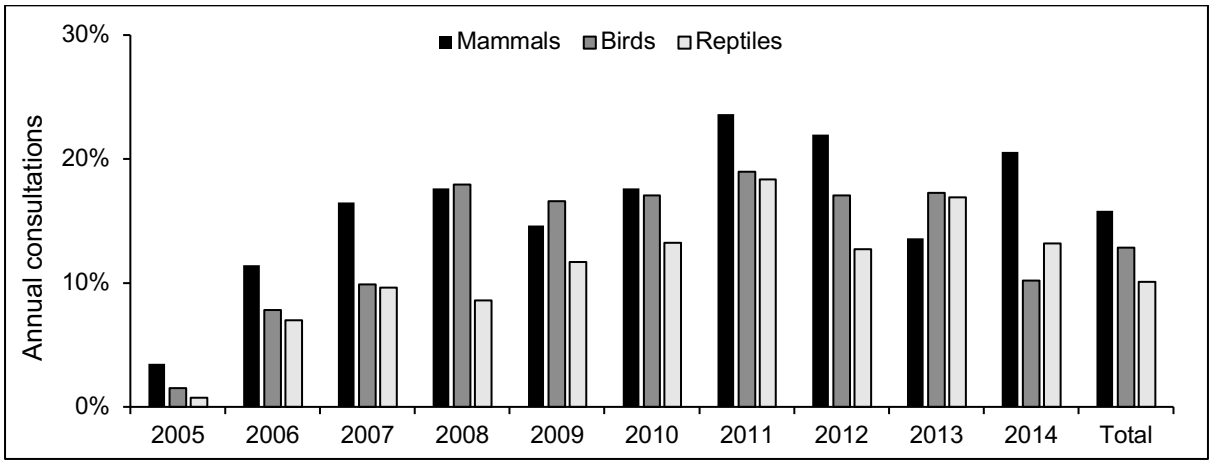

Figure 35 *Consultations for animals that had been presented 4 times before at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 2005 to 2014*

6.4.3 Referrals

Comparing referral rates from 1994 to 2003 with those from 2005 to 2014 there was a significant increase in referrals for mammals, a steady referral rate of 5% for birds and a decreased referral rate for reptiles. Even though the clinic should be considered as a referral clinic due to the high standard of care and the spectrum of possible diagnostic methods and specialists, there seems to be little need for private practitioners to refer patients. The reason might be either that cases which require a high level of expertise come directly to the clinic, or that private practitioners are versed enough in the most common diseases to treat the animals themselves. Another explanation would be budgetary constraints of owners, who might not be willing to pay several times the monetary value of their pet to seek specialised treatment.

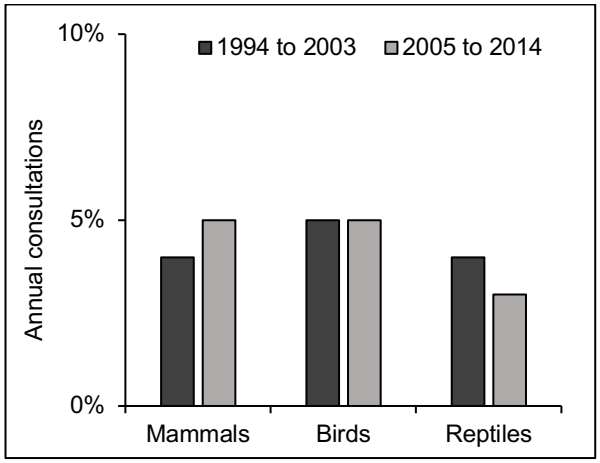

Figure 36 *Percentage of referrals for animals presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 1994 to 2003 (Langenecker, 2006) and 2005 to 2014*

6.4.4 Outcome

6.4.4.1 Discharged animals

In the previous study 26% of all animals were euthanized or died, which is 9% more than in the more recent time period (Fig. 5). The percentage of birds that died during their stay was previously recorded as 13% compared to 9% in the recent study.

6.4.4.2 In-patient admission

In the previous study reptiles were most commonly treated as in-patients with 64%, birds were second with 49% and mammals 38%. More recently, the percentage of in-patient consultations decreased significantly for every class. Animal welfare is an influencing factor, as it is generally accepted, that recovery is most successful in a familiar environment, taking into consideration the owner's compliance to continue treatment. Streamlining of procedures in the clinic and again limitations in regard to the owner's budget could also have played a role.

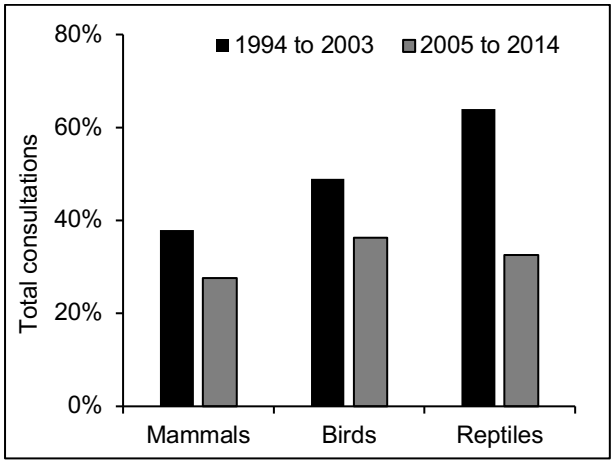

Figure 37 *Percentage of animals admitted for in-patient stay at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) between 1994 to 2003 (Langenecker, 2006) and 2005 to 2014*

6.4.4.3 Post-mortem diagnostics

Compared to the years 1994 to 2003, there is a decrease in post-mortem diagnostic in reptiles from 35% to 29% and an increased for birds from 33% to 35% (Fig. 6). Birds could have a higher post-mortem exam rate because they are also more likely to die during their stay due to their delicate physiology. Post-mortem exams have to be agreed to by the owner and an increase in the emotional attachment could lead to less willingness to agree to them. Or, in case of the reptile owners, the financial aspects may also be of importance. Population based problems, which are more common in birds and reptiles, could also inflate the percentage of post-mortem exams per class. Likely, the owner's willingness to sacrifice a sentinel animal is also higher in birds or reptiles where emotional bonds are not so tight, withstanding exceptions.

6.4.5 Antibiotic treatment

The topic of antibiotic treatments warranted a separate paragraph because of the global threat of antimicrobial resistance. Efforts to implement antibiotic stewardship should be made at every level of antimicrobial use – veterinary and human healthcare as well as agriculture and includes many elements like practice guidelines, dosage considerations, clinical microbiology data, education and many more (Guardabassi and Prescott 2015). There are several barriers in exotic animal practice that make antibiotic stewardship challenging. The large variety of diseases and localisations as well as the large number of species make it almost impossible to have a thorough knowledge of all involved bacteria. Culture and sensitivity testing should be used routinely however lack of the appreciation of importance from the side of the veterinarian or cost restriction from the side of the owner, result in an underuse (Broens and van Geijlswijk 2018).

The treatment options are often limited by the size and compliance of most patients. Concentration, formulation and acceptance by the animal as well as available dosage information are the most important selection criteria for antibiotic medication in exotic animals. In small herbivorous mammals, veterinarians only have a limited choice of antibiotics that do not cause dysbiosis and enterotoxaemia. Fluoroquinolones, third generation cephalosporins and beta-lactams are widely used (Broens and van Geijlswijk 2018). But also, in general small animal practice fluoroquinolones and beta-lactams are most commonly prescribed (Fowler et al. 2016). Only 12% of veterinarians stated, in a survey, to frequently (50-75% of the time) request a culture and sensitivity (C/S) test, mentioning costs as the main obstacle (Fowler et al. 2016).

In the present study, it could be shown that 34% of all patients received antibiotic treatment, and a negative trend can be observed in the most recent years. Animals that came in for follow-up visits and were still treated with antibiotics were not included in the calculations. Birds had the highest percentage of treated animals with 39%, reptiles 34% and for mammals is was 32%. A culture and sensitivity test was only recorded for 10% of the animals that were treated with antibiotics and it was most commonly ordered in birds.

Rats had a notable high rate of antibiotic treatment with 90% of patients receiving at least one antibiotic agent – 24% received two. Culture and sensitivity testing were performed for 2% of treated animals. This species typically has a high rate of antibiotic treatment (Rey et al. 2015) but it should be critically discussed if for example animals should be treated with fluoroquinolones after orchiectomy. The 27% of castrated rats which received antibiotic treatment, were from the same owner which had previously presented animals post castration with high rate of infections. Inbreeding or immunodeficiency due to other factors might have influenced the decision to treat other animals preventively. Culture and sensitivity testing in respiratory disorders in rats is also very challenging. For example, *Mycoplasma ssp*. are difficult to cultivate (Brown and M. Donnelly 2012). Another factor is certainly owner compliance to cover the cost of C/S testing as surveyed by Fowler et al. (2016)

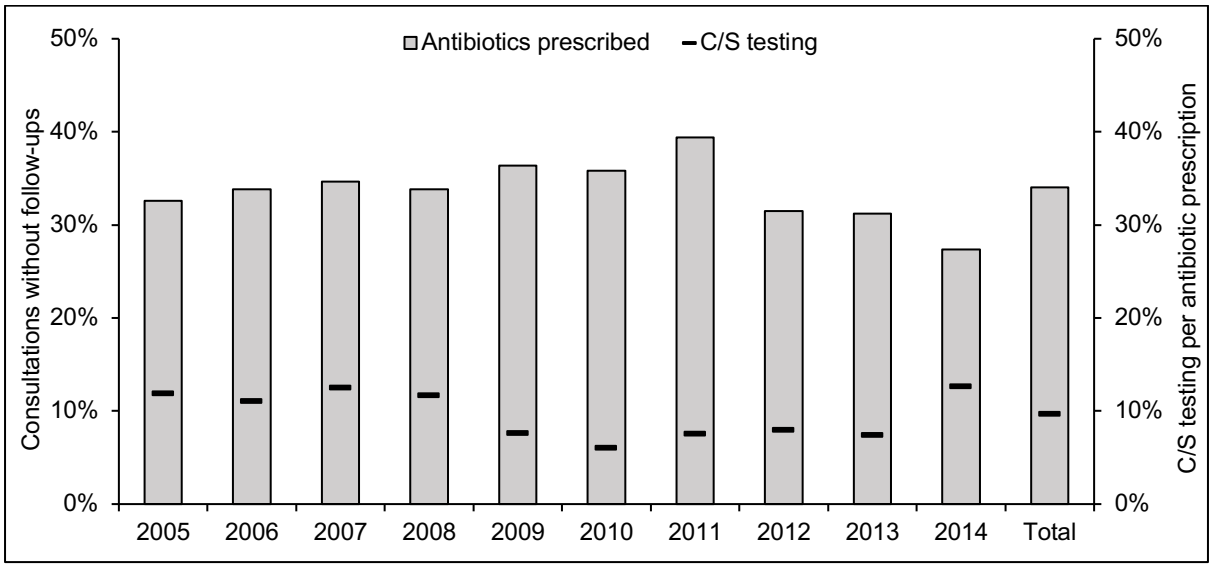

Figure 38 *Antibiotic prescriptions at the at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) and the percentage of C/S testing between 2005 to 2014*

To improve the responsible use of antibiotics, veterinarians should remind themselves to follow guidelines for example form the Federation of European Companion Animal Veterinary Associations (FECAVA 2018). These guidelines involve a flowchart for easy decision making and also give the advice on C/S testing. It is important to teach those guidelines to veterinary students as early on as possible. Castro-Sánchez et al. (2016) observed that all 6 veterinary programs in the UK were teaching antibiotic stewardship, but they advise further emphasis on stewardship to develop optimal antimicrobial prescribing behaviours.

6.5 Mammals

6.5.1 Mammal species

The top four mammal species (rabbit, guinea pig, rat and chinchilla) stayed the same since 1994 (Tab. 20). This distribution is in agreement with almost all studies since 1999 showing that rabbits are the most common mammal species in exotic pet practice followed by guinea pigs (Tab. 2). Over the last 20 years however, the percentage of guinea pigs in annual mammal consultations decreased significantly ($p<0.01$). This decrease was already seen in Kraft (2005) and Langenecker et al. (2009). On the other hand, the share for all rodent species stayed steady at 57% of annual mammal consultations. The decrease in guinea pigs was completely compensated by an increase in other rodent species. For example, the consultations for degus increased significantly from 1% in 1994 to 4% in 2013 ($p<0.02$). This small rodent species has become a popular pet with Long (2012) stating their curiosity, relative longevity and gentle nature as a reason for their increased popularity.

The ferret, which had an increase of 7% in the last study period (Langenecker et al. 2009), showed a significant decrease again to 0% in 2014 (4 consultations in 2014). While ferrets were still increasing in popularity in the US after 2000 (Antinoff and Hahn 2004), there seems to be a general downward trend. Pet ownership estimation from the US saw a decrease from 2007 to 2012 of 30% and they seem to go out of fashion again in Switzerland as well. It could be hypothesized that this is due to strictly regulated husbandry conditions and the required licence (Swiss Federal Council 2008), or due the fact that the animals are very prone to different disease such as neoplasia (Antinoff and Hahn 2004).

Based on the recent results of the species distribution for the small mammals, it is recommended to focus the curriculum on rabbits, guinea pigs and small rodents and invest less time in ferret medicine.

6.5.2 Rabbits

Several studies have shown that dental disease is the most common diagnosis for rabbits in veterinary practice (Möller (1984), Kirschbaum (1994), Fehr (1999); Langenecker et al. (2009); Rheker (2001), Nielsen et al. (2014)). Some of these studies also mention dermatologic disorders as an important diagnosis. In our clinic, 11% of rabbits were diagnosed with a dermatologic condition.

To compare the numbers directly, additional data like the rate of emergencies and referrals would be interesting. The results from this study showed that gastrointestinal tract disorders were a common reason for emergency, which has an effect on the overall numbers.

6.5.2.1 Dental disease

Dental disease was also the most common diagnosis for in both study periods with again a significant increase in the recent study period (Fig. 8). One rabbit was presented a record 42 times because of its dental problems. Males were generally affected more often than females (Tab. 22), even when correcting for the gender mismatch over all presentations. Harcourt-Brown and Baker (2001) found no gender difference for 81 rabbits with dental disease, and neither did Jekl et al. (2008). There are no further mentions of gender differences, with exception of a possible impact of an altered calcium metabolism on dental disease (Jekl and Redrobe 2013), and one study found significantly more enamel defects in female rabbits compared to males, but only in very young animals (Korn et al. 2016). Prospective studies on dental disease in rabbits were either performed with female only groups (Müller et al. 2014) or the gender was not referenced (Meredith et al. 2015).

The treatment with tooth correction (78% vs. 61%) and supportive care with force feeding (21% vs. 20%) did not change between the study periods. Antimicrobial treatment with enrofloxacin increased from 12% to 25%. The policy of responsible use of antimicrobial substances demands a more thorough analysis of the use of enrofloxacin. Dental disease with abscess formation was diagnoses for 30% of rabbits with dental disease that were treated with enrofloxacin. A concurrent diagnosis that potentially justified the use of an antibiotic agent was recorded for 48%. For 23% of rabbits with dental disease, the clinical reason for treatment with enrofloxacin could not be ascertained from the patient record. The outcome was positive for nearly the same percentage of animals as before (86% vs. 89%), but in the new study 65% were released from the hospital with medication compared to 41%. A negative outcome was slightly less likely (11% vs. 14%) but the percentage of animals euthanized did not change (9%).

Considering the high percentage of animals affected in this study, dental disease in rabbits should be a priority in veterinary training. The proposed aetiologies for dental disease are diverse and range from genetic to nutritional. The consulting veterinarian should therefore have sound knowledge of the anatomical (Vella and Donnelly 2012) and nutritional peculiarities (Clauss 2012) of rabbits.

6.5.2.2 Castration

From 2005 to 2014, 208 rabbits were castrated. Males amounted to 87% of all castrations and were on average 0.6 years old. Castration in male rabbits are mostly done to avoid reproduction an interspecies aggression. Considering that up to 80% of all female rabbits develop a uterine adenocarcinoma during their lifetime, it is disconcerting that only 13% of castrations were for females even if the procedure is more invasive and consequently more expensive (Klaphake and Paul-Murphy 2012).

6.5.2.3 Encephalitozoonosis

Encephalitozoonosis was diagnosed in 12% of rabbits either due to clinical signs or serological testing. Older studies found only a prevalence of 2% (Rheker 2001), whereas newer publications from Germany (Hein et al. 2014) and Italy (Lavazza et al. 2016) report 43% and 38% respectively. Encephalitozoonosis is a well discussed topic in the veterinary curriculum in Switzerland, and the low rate of cases seen could be explained by a good knowledge of private practitioners about the disease and a relatively simple treatment protocol that does not require prolonged hospital stays unless the animal has a very severe case of the disease.

Regarding treatment, the wide-spread use of fenbendazole is reflected in the new study period (35% vs. 59%). The use of antibiotics in rabbits with encephalitozoonosis has to be discussed critically. In the present study, 33% of patients were treated with Enrofloxacin, which was previously used only in 5% of patients (Langenecker 2006). Antibiotics are only recommended to treat infections with similar clinical signs (*Otitis media/interna*, meningo-encephalitis) or secondary infections (Harcourt-Brown and Holloway 2003) until the diagnosis is confirmed. With the speedy performance of serology testing and studies that showed that only very few rabbits with the typical neurologic signs suffered from otitis instead of encephalitozoonosis (Kunzel et al. 2008; Sieg et al. 2012), the use of antibiotics should be minimised. The third cornerstone usually involved corticosteroids such as dexamethasone to reduce inflammation of the CNS. Dexamethasone was given to 28% of rabbits with encephalitozoonosis (Tab. 22). Sieg et al. (2012) found no effect of dexamethasone on short- or long-term survival. A switch to Meloxicam to avoid the severe immunosuppressive effect of dexamethasone was therefore implemented (2009 dexamethasone 38%, meloxicam 12%; 2014 dexamethasone 39%, meloxicam 56%). In the current study, 82% of patients could be released home, which is similar to the 84% of Sieg et al. (2012) and a slight uptick compared to the previous study period (70%). However, no conclusion can be made from the data set about long term survival, which is published at 53% after 6 month (Harcourt-Brown and Holloway 2003).

6.5.3 Guinea pigs

Results for the top 10 diagnoses in guinea pigs are similar to a recent study from Minarikova et al. (2015) on the same subject. However, urinary tract disorders were more frequent in this clinic (12% vs. 9%) but there were less ophthalmologic disorders (8% vs. 15%).

6.5.3.1 Diagnostic methods

There is a notable difference in the percentage of blood sampling from guinea pig patients to rabbit patients. In guinea pigs, blood samples were taken only from 11% of animals (Tab. 24); in rabbits the percentage was 65%. Blood collection in guinea pigs is notoriously difficult and usually requires a short anaesthesia (Quesenberry et al. 2012). The risks and costs involved are certainly a reason why it is less likely recommended to owners by the attending veterinarian and why the owners themselves might reject this procedure.

6.5.3.2 Dental disease

Just as in rabbits, dental disease was the most common diagnosis in guinea pigs with 22% (Tab. 23). There was an increase of 10% compared to the last study period, but the recent numbers are in agreement with guinea pigs seen by Jekl et al. (2008). Minarikova et al. (2015) reported a prevalence of 36% for dental disease among 1000 clinical patients at the University of Brno. Dental disease affected more male than female guinea pigs. This gender asymmetry was already seen in rabbits, and it was previously reported in other studies (Minarikova et al. 2015; Schweda et al. 2014; Stoffels-Adamowicz 2014) without any hypothesis about the aetiology. Treatment with tooth correction, antibiosis, vitamin C and supportive care did not differ between the study periods. Nevertheless, there was an improvement in outcome: 83% (vs. 72%) were released, 53% (vs. 35%) with medication. This means a decrease in deceased animals from 28% to 17% between the two study periods. An explanation for this improvement could be that the animals continue treatment at home and are followed up more intensively. In the previous study period only 25% of animals with dental disorders received medication after their discharge compared to 72%, and just 5% were presented more than once compared to 59% in the recent study (Tab. 24).

6.5.3.3 Urinary tract disorder

Animals with urinary tract disorder showed a significant increase between the two study periods (5% vs. 12%) and also significantly increased from 2005 to 2014 (p=0.03). Minarikova et al. (2015) reported only 4.2% of guinea pigs with a urogenital disorder including cystitis. Referral rate for guinea pigs with a urinary tract disorder was higher than for any other disorder. The workup of urinary disorders requires imaging techniques such as radiography, ultrasound and might include also cystoscopy which have been proven to be very helpful (Wenger and Hatt 2015). The infrastructure and expertise developed at the clinic could very well be the reason for the increase in consultations.

6.5.3.4 Ophthalmologic disorders

A large survey of 1000 guinea pigs (Williams and Sullivan 2010) found that 45% of guinea pigs presented with ocular abnormalities (e.g. 17% cataract, 21% subclinical lens abnormalities, 4.7% keratitis). The low prevalence for ophthalmologic disorders is most likely due to the subclinical nature of these conditions. Adjusted husbandry recommendations given to owners, which emphasize the importance of dust and straw free bedding to avoid injuries to the cornea or conjunctiva, might have influenced the decrease seen since the last study period.

6.5.4 Rat

In rats the methodical differences between the studies do not allow a direct comparison. Especially neoplastic diseases were grouped in a different manner. Kirschbaum (1994) categorised all neoplasia as one diagnosis as did Fehr (1999). Langenecker (2006) noticed that for 54% of neoplasia, no exact localisation was indicated in the records. Rey et al. (2015) sorted all diagnoses first by organ system and found the same top 3 diagnoses as the current study and the most common reference book (Brown and M. Donnelly 2012) namely respiratory, reproductive and dermatologic disorders.

6.5.4.1 Diagnostic methods

A diagnostic work-up after the initial clinical examination was only run for 20% of rats compared to 54% of rabbits. It is also less than the reported rate of 39% from a similar study in France (Rey et al. 2015). Otoscopy and oral endoscopy are included in as a diagnostic test in the French study. These two diagnostic tests are routinely performed as part of the initial clinical examination at our clinic.

6.5.4.2 Reproductive tract disorders

The most relevant diagnosis of the reproductive tract disorders was mammary gland neoplasia affecting 11% of all rat patients. Langenecker (2006) found a prevalence of 9%, Rey et al. (2015) reported 11%. Vergneau-Grosset et al. (2016) reported 20%.

The mean age at presentation was 1.8 years, and 20% of rats with mammary gland tumours were presented to the clinic for unspecific or clinically different reasons (i.e. anorexia, scratching). The same was noted by Vergneau-Grosset et al. (2016), who stressed the importance of a thorough clinical exam. A surgical approach was used for 49% of rats, after which all animals were successfully released home. A recurrence of the mammary gland tumour was noted for 9 out of the 48 animals that underwent surgery 2 to 9 months after the initial excision. Half the animals that did not undergo surgery were euthanized. In the previous study (Langenecker 2006), 60% of animals underwent surgery and 34% were euthanized. An explanation for the greater success in recent years could be the younger mean age at presentation (1.8 years) or refined treatment protocols and surgical technique.

6.6 Birds

6.6.1 Avian species

Since the study of Langenecker (2006), a species distribution among the avian patients has changed. A decrease in all large psittacines species as well as in the popular budgerigar (Tab. 28) was observed over the two study periods. Since 2001, the ownership of large parrots (macaws and large cockatoos) requires a special permit, which could explain the drop for these two species. The psittacines species however remain the predominant avian patients as seen also in the literature (Diener 2015; Hill and Williams 2006), and the decrease in the popular species is in part equalled out by an increase in other *Psittaciformes* (Fig.39). Another species that has become almost irrelevant is the common hill mynah. There were only 2 consultations for mynah in the current study period compared to 58 in the previous one, and the last recorded consultation was in 2006. The mynah were popular pets due to their ability to imitate human speech (Archawaranon 2006). They are, however, very specialised feeders and susceptible to iron overload disease, and due to a massive increase in trade, they were also listed in the CITES II appendix (CITES 1983). The increasing number of consultations for backyard poultry species (Tab. 28) has been described in international literature (Greenacre and Morishita 2015). It is recorded as the fifth most common species in Northern Europe (Speer et al. 2016). The purpose of backyard flocks varies from small scale meat and egg production to companionship similar to dogs and cats.

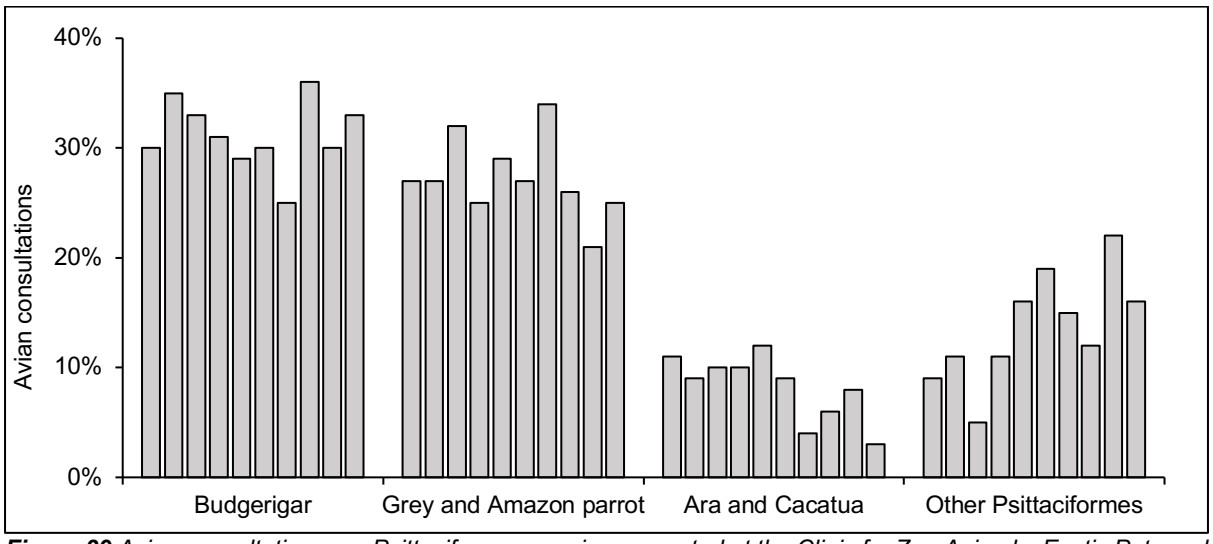

Figure 39 *Avian consultations per Psittaciformes species presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife (University of Zurich, Switzerland) for 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010, 2012 and 2014*

6.6.2 Budgerigars

Gastrointestinal tract disorders and dermatologic disorders accounted for more than 50% of all consultations for budgerigar (Tab. 29). Due to different methodology, a direct comparison to the previous study period is not possible. Comparison with other sources, however, confirm that gastrointestinal tract disorder, dermatologic disorders and neoplasia of various organ systems are the most common diagnoses for budgerigar presented to the veterinarian (Albicker-Rippinger and Hoop 1999; Langenecker 2006; Pustow and Krautwald-Junghanns 2017; Schuetz 2011). The percentage of animals with a recorded obesity stayed steady at 3% over the two study periods, but for more than 25% of animals the clinical body condition score was marked as overweight.

A very important and albeit cheap diagnostic tool used in avian medicine is the microscope. For 20% of all budgerigars, crop cytology or faecal smear slides were evaluated (Tab. 30), making the microscope just as relevant as a radiograph. Microscopy should therefore be addressed frequently in the curriculum, and practical sessions could help strengthen theoretical knowledge of microscopic finding in birds.

Budgerigars hide signs of disease or discomfort to avoid catching the eye of a potential predator. This could explain why they have almost the highest rate of emergency consultations (Tab. 30). For teaching purposes, the behaviour of a normal budgerigar has to be compared with the subtle signs of a potentially sick bird i.e. fluffed up feathers, lameness, reduced vocalisation and others.

6.6.3 Amazon parrots

The top four diagnoses for Amazon parrots have remained the same for 20 years (Tab. 31). Respiratory tract disorder and dermatologic disorders are the predominant diagnoses. Dermatologic disorders however, do not necessarily describe a clinically relevant disease. Overgrown beak and claws made up 89% of all dermatologic disorders from 2005 to 2014. In the previous study period, 15% Amazon patients were recorded for beak or claw correction and the other 5% for wing clipping. Such consultations have seen a severe decrease, probably because private practitioners are better equipped and educated to perform these procedures.

Respiratory tract disorders were diagnosed in 25% of Amazon patients. The causative agent was suspected to be *Aspergillus* in more than 70% of patients. This diagnosis was more common in animals presented between October and February. Langenecker (2006) also found that significantly more animals were diagnosed with aspergillosis in winter. The main treatment until 2003 was systemic administration of itraconazole. Itraconazole was also the main antifungal agent in the current study (71%). Itraconazole has some drawbacks, as it takes several days of administration to achieve therapeutic plasma levels, and some resistance has been reported. Voriconazole is reported as the antifungal agent of choice against aspergillus in a recent review (Krautwald-Junghanns et al. 2015). Antibiotic treatment was administered to 65% of animals. In the current study, 54% of animals were treated with enrofloxacin versus 31% in the previous study. Inhalation therapy was recommended for 45% of all patients. The outcome for animals with respiratory disease was similar in both study periods.

6.6.4 Grey parrots

The main diagnoses were the same for Grey parrots as for Amazons, which is consistent with the findings from the previous study period and reflect the commonly encountered problems all around Northern Europe in these species (Speer et al. 2016). Grey parrots in general were younger, with 37% being less than 10 years old compared to Amazons with less than 26%.

Regarding the gender distribution, there were two remarkable findings: dermatologic disorders affected males more than females (Tab. 34) as in Amazon parrots (Tab. 32), and trauma affected females more than males, unlike in Amazon parrots. Pathological fractures due to egg laying activity could predispose females as trauma patients (Stanford 2007) but only one female Grey parrot was diagnosed with a fracture and a concurrent calcium deficiency.

In the previous study, 9% of Grey parrots showed abnormal behaviour in the form of feather plucking, it was not shown in Amazon parrots however. Feather damaging behaviour is still considered one of the most common and frustrating conditions in captive parrots (van Zeeland et al. 2016). Assuming that a parrot with a complete plumage is an exception in veterinary practice, it is understandable that feather plucking and other feather damaging behaviours were only recorded as a diagnosis if this was the presenting complaint and there was no other diagnosis to explain the behaviour. In the current study, only 0.5% of Grey parrot were diagnosed with a feather damaging behaviour.

6.6.5 Backyard poultry

As mentioned above, backyard poultry have become regular patients over the recent study period. Practitioners consulting for backyard poultry are presented with a multitude of challenges ranging from medical to legal issues (Nixon 2014). For example, female animals with the potential for egg laying make up at least 55% (Tab. 36), and the rate of antibiotic treatment per consultation is higher (55%) than for most exotic the pet species. Regardless of whether the animals are explicitly used for egg production, the use of antibiotics specifically, and the off-label use of other drugs in general as well as their respective withdrawal periods, has to be considered carefully and with full acknowledgment of the owner. This topic needs to be addressed in detail during primary or secondary education of veterinarians.

Trauma is a very important presenting complaint in backyard poultry. Predator safe enclosures for backyard poultry need careful planning, execution and regular safety checks (Karcher 2015). Traumatic injuries however have a better recovery rate than other disorders in backyard poultry (Tab. 36).

6.7 Reptiles

6.7.1 Reptile species

The *Testudines* remain the most popular reptiles as shown not only in this study but also in the previous years and in the literature (Hill and Williams 2006). *Testudines* remained stable at 40% while the *Serpentes* decreased by 6%. *Sauria* species gained in popularity as a 5% increase can be seen between 1994 to 2003 and 2005 to 2014 maily due to the bearded dragons (7% increase). Wright (2008) attributes their popularity to their relative ease of care, size and engaging personalities but warns that they are also very likely to develop diseases due to un- or misinformed owners. Data from the American pet trade industry showed opposite results, with *Serpentes* as the largest group (34%) and *Testudines* with only 14% (Barten 2006).

The decrease in Slider turtles and green iguanas reflect a change in the animal welfare law. For the green iguana, it is mandatory to take a course and apply for a permit before acquiring an animal. The popular *Trachemys scripta elegans* has been classified as an invasive alien species, and private ownership has been restricted (Swiss Federal Council 2008). The decrease of *Trachemys scripta elegans* was partially compensated by *Trachemys scripta scripta* and other *Trachemys* species (Fig. 23). The decrease of the *Serpentes* is due to decrease seen over all species except for the corn snake. Both the *Boa constrictor* and the ball pythons showed a short peak during the BIBD crisis. The decrease in popularity of snakes cannot be explained. There were no concrete changes in the legislature or trade restrictions. On the contrary, especially for the non-poisonous ball pythons and *Boa constrictor*, there are now over 10’000 colour morphs and breed (Pasmans et al. 2017) variations on the market, which should in theory appeal to a wide public.

6.7.2 Tortoises

The predominant diagnosis for tortoises is gastrointestinal tract disorders – the same as in the previous study. The aetiology of the gastrointestinal disorders is very often a parasitic infection. However, there was a significant decline for this diagnosis in the recent years (Fig. 22). In recent years, endoparasites have been recognised as part of the normal gut flora of reptiles. A clinically relevant parasite load is most often the result of inadequate husbandry, and therefore not every parasitic infection has to be treated (Greiner and Mader 2006). Good knowledge of the pathogenicity of the common endoparasites in chelonians (or reptiles in general) should therefore be an important part of the exotic pet curriculum, also to avoid unnecessary treatment which always incorporates the risk of toxicity to the animal or of the development of resistant organisms.

Another diagnosis that is increasing in percentage is trauma. Most often the injury is not described in detail, but bite or fall injuries are often mentioned (Tab. 40) and these were the reason for the largest percentage of emergency consultations in tortoises. Bite wound or shell fractures have been reported as a very common reason for presentation of chelonians in emergency care (Music and Strunk 2016). It can be hypothesized that owner awareness to the special requirements of tortoises had increased in recent years as seen by an increase for health checks and a decrease of diagnoses for metabolic bone disease. Housing tortoises outside with natural sunlight makes them more prone to trauma from predator animals or other aetiologies, which could explain the increase of traumatic injuries in general.

6.7.3 Slider turtles

Regarding the identity of the animals, there was a difference between the tortoises and Slider turtles. Even though Slider turtles commonly show a clear sexual dimorphism (Boyer and Boyer 2006), the gender was determined less often than in tortoises. Also, given the different longevity of the animals the results showed that tortoise patients were mostly under 10 years old while Slider turtles were over 10 years old (Tab. 40, 42). The most common medical issue in Slider turtles are ophthalmologic disorders originating from insufficient supply of vitamin A (Tab. 41). It is recognised also internationally as the most common disorder in small aquatic turtles. (Boyer 2006). Other important diagnoses were dermatologic disorders, trauma and reproductive tract disorders. The surgical approach to reproductive tract disorders is more complicated compared to mammals due to the shell which might be a reason for referring these patients (Tab. 42, Fitzgerald and Vera (2006)).

6.7.4 Bearded dragons

The mean age in the current study was 4.2 years, which is higher than previously reported (Schmidt-Ukaj et al. 2017), but it shows that subadult animals are the most common patients. Consistently, female bearded dragons are presented more often than males. This is probably due to common husbandry conditions which propose single-housing for males whereas females can easily be group-housed.

Regarding the disorders of this specie, the gastrointestinal tract was the most commonly affected organ in the studies from this clinic but also in the references (Wright 2008), and endoparasites were the main aetiology. Systematic health checks are a valuable tool to detect clinically relevant parasitic infections, and the results show that owners are willing to bring in their animals for health checks as they already represent 9% of all consultations for bearded dragons (Tab. 43). Since the last study in this clinic, the trauma patients and the animals diagnosed with metabolic bone disease show a downward trend, suggesting that either husbandry conditions have improved or private practitioners have become more versed in the treatment of these conditions. Hepatic disorders are less often reported in the current study (Tab. 43) compared not only to the previous study but also to the available literature . Schmidt-Ukaj et al. (2017) suggest to incorporate bile acids to better detect hepatic abnormalities, but owner compliance and sufficient blood sampling may hamper this diagnostic approach.

6.7.5 Boidae

During the current study period, the causative agent of BIBD has been discovered and with the development of testing improved testing methods BIBD has been recognised as the most important disease of boid snakes worldwide (Marschang 2014). Clinically the animals can present with dysecdysis, stomatitis, pneumonia, neurologic disorders and other disorders (Chang and Jacobson 2010). It is perfectly possible that the high percentage of animals with these conditions as detected by the previous study (Tab. 45) were due to a BIBD infection.

Euthanasia rate was very high in animals with BIBD (Tab. 45) as 48% of animals were presented to detect or control several private collections. The prognosis for an individual snake, however, is still difficult to determine, as some animals only harbour a subclinical infection while others develop the fatal form of the disease. Co-infections with other viruses may represent a factor in the severity of the disease (Hepojoki et al. 2015). Future veterinarians and specialised practitioners should be encouraged to keep current with the current research in this field.

6.8 Conclusion

Regarding the requirements for the education of veterinary students and practitioners, the following recommendations are derived from this study:

Small mammals are still the most important patients in exotic practice and a good knowledge of their physiological and pathological conditions should be part of a veterinarian's basic education. The diagnosis and treatment of dental disease requires additional practical expertise.

In avian medicine, a veterinarian should have some knowledge about small and large psittacines species. The former being more afflicted by gastrointestinal disease, the latter by respiratory tract disorders. An emerging branch of avian medicine is backyard poultry medicine. A basic education in commercial poultry does not suffice to treat these patients to the customers' and the law's full satisfaction.

Herpetological medicine remains a vital part of exotic animal practice. Veterinarians should focus on a good expertise with the most common species of tortoises, snakes and lizards (e.g. tortoises, bearded dragon and corn snakes.

It should be in every professionals' own interest to continue education after graduation as species and disease complexes are evolving constantly and there are more and more possibilities for special training in exotic pet species.

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